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Electrical World

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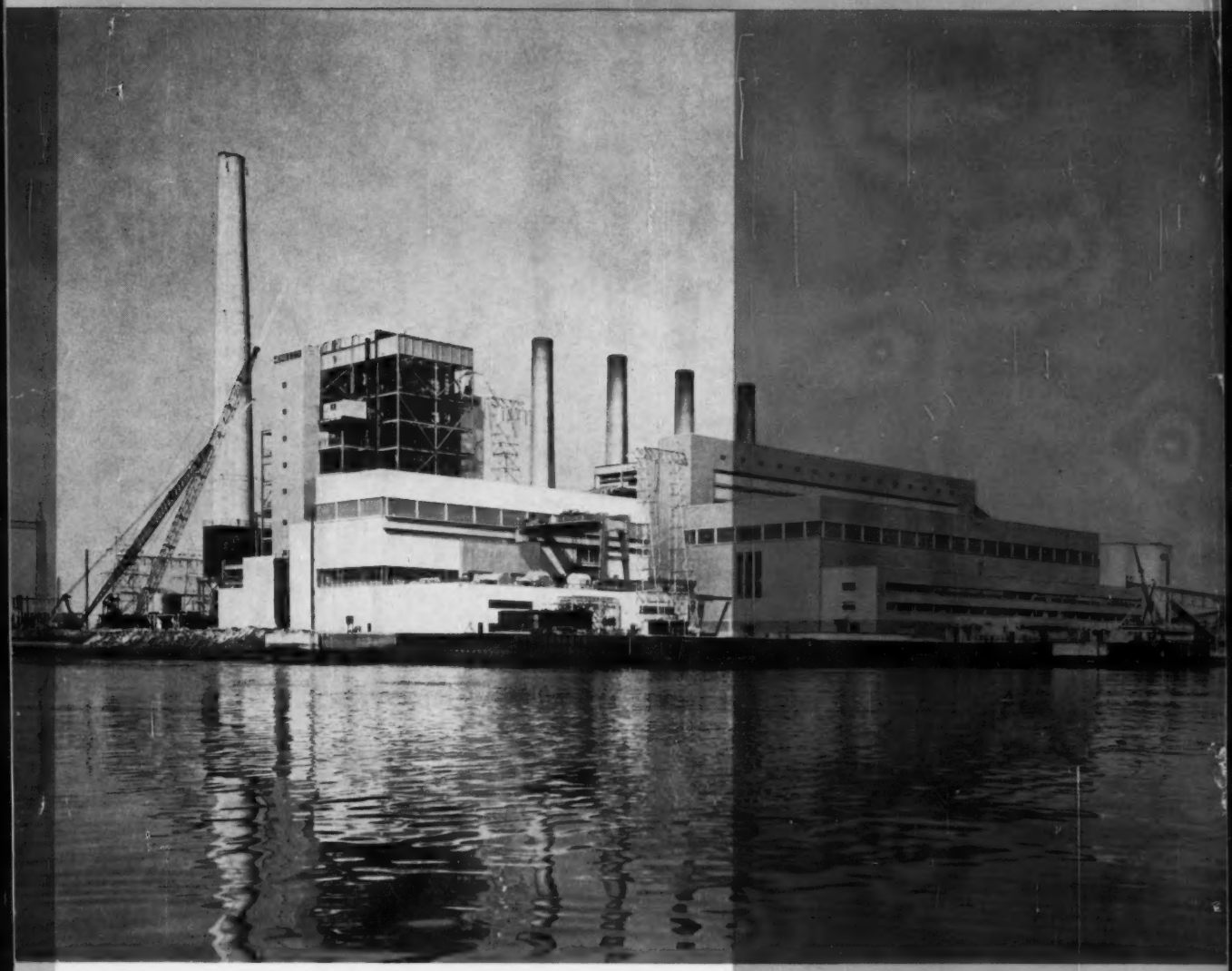

Automatic Control Slated for Sewaren 342-Mw Unit 5...

...page 54

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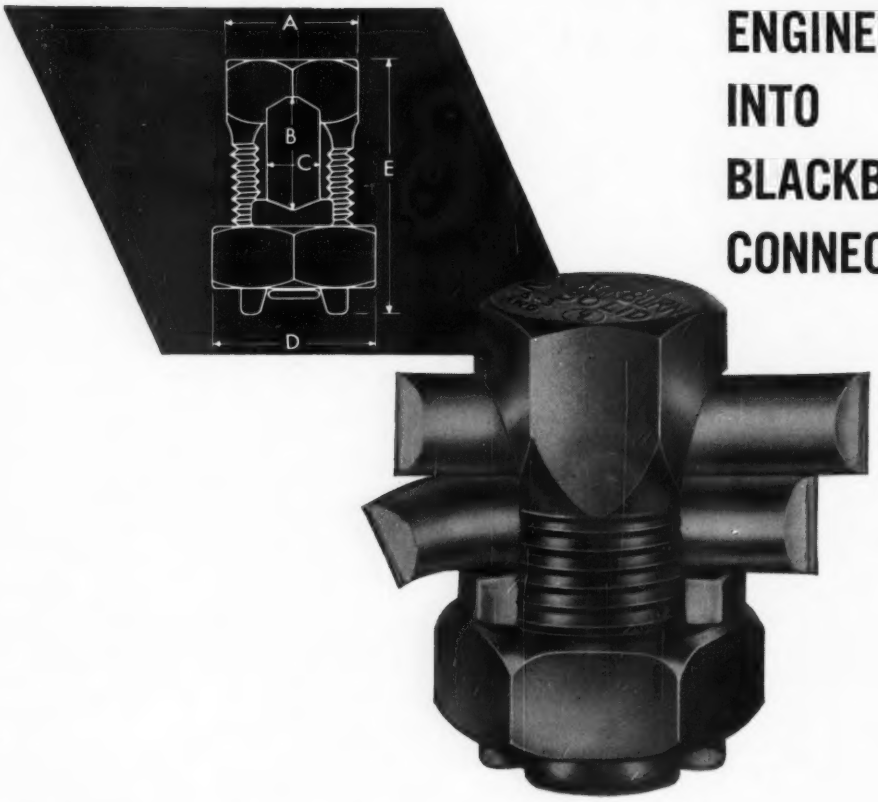

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Electrical World

NOVEMBER 13, 1961
Vol. 156, No. 20

Dateline . . .

'Common Carrier' – Concept or Slogan?

Washington, D. C.—"Common carrier," relating to transmisson lines, is one of the key phrases of the Kennedy Administration. It's been something of an enigma to many who have tried to pin it down.

The present Democratic leadership, of course, still is fairly new in Washington and it hasn't had time to take care of, in one way or another, all the promises and phrases it voiced during the 1960 campaign and in its first few months in office. "Common carrier" is one of those phrases.

Although both President Kennedy and Interior Department leaders have used the phrase on several occasions, no clear-cut definition has been forthcoming.

An Interior task force report on the Bonneville-California intertie—due about mid-November—may provide that definition for the first time. The big line has been promoted as a common carrier, moving power for all comers, so the task force has been directed to define the phrase, and report how its principle could be applied to the big line, whether built by the federal government or a non-federal system.

Interior officials have used the phrase primarily as a principle—that of requiring excess line capacity in any line, federal or non-federal, to be made available for use by any other system which wanted to use it. This would provide for the interchange and firming up of power on some systems, and of course, it would make more transmission capacity available for delivery of federal power to preference customers.

Whether this method of interchange—enforced common carriage—would be better or worse than more interconnections and displacement is something the department still must study.

Common carriage, restricted to the use of excess line capacity, would be limited to the availability of that capacity. On this basis, some observers have passed off the term as a "Madison Avenue" phrase meaning wheeling—except for the legal enforcement. Public power spokesmen, however, feel that there is sufficient excess capacity on existing utility lines to make the venture toward common carriage worthwhile. And the phrase does have political appeal in urging its adoption for new federal lines.

Former Interior Under Secretary Clarence Davis,

(*Continued on page 5*)

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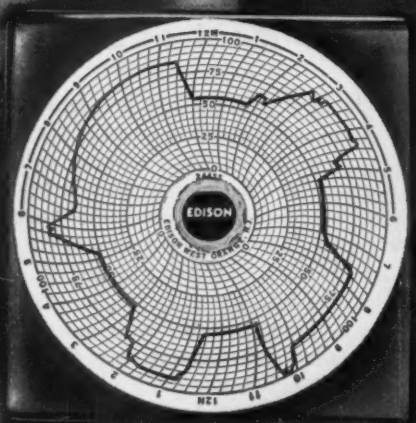

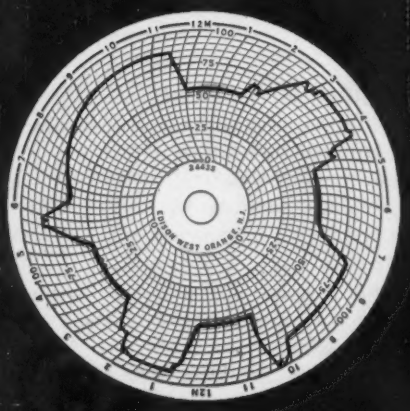

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Dateline . . .

Washington, D. C. (*Continued from page* 3)
incidentally, took a dim view of the whole concept during 1956 hearings on Interior power policies by the Chudoff subcommittee in the House of Representatives. Davis said the concept was unsound, both economically and electrically, if carried out "without complete collaboration." He said "common decency" would prevent a line owner from cutting off other users if his own operations required use of the "excess capacity." Thereby the owner's own system would suffer economically from the principle. Also, minor variations in power frequency could "hog" power for one user, he added.

There is no instance of common carriage in actual operation today, although Reclamation Commissioner Floyd Dominy feels the wheeling arrangements in the Southwestern Power Administration area "come closest" to the concept.

But the lack of a clear definition, or failure to effect a practical application has not deterred attempts to bring this concept into being:

- The Interior Department, from 1948 to 1954, issued an order that all utility lines crossing public lands be operated as common carriers to the extent that they had excess capacity. The order was never applied.
- The Federal Power Commission, at the request of the department, required that Idaho Power Co make available excess capacity on its new lines from the Bliss hydro-power project for possible use by the federal government. Again, the government never took advantage of the requirement, although the order was litigated all the way to the US Supreme Court, where its legality was supported.
- Rep (now Senator) Quentin Burdick (D-N. D.) introduced legislation in 1959 in the House of Representatives to require that all interstate transmission lines be operated as common carriers. His bill (HR-3142) never was acted upon.

Letters

Timing of Conductor Changeovers

▶ We are glad to offer these thoughtful comments from I. V. Czeskleba, an electrical engineer with the Rural Electrification Administration:

To the Editor:

The article on economic conductor sizing by F. F. Gray in the Sept. 25 *Electrical World* is timely and pertinent. Too often attempts are made to resolve economic conductor sizing in growing load situations through single computation methods.

I wonder if Mr Gray's concept might not be made more valuable by further exploration of the timing for changeout of existing conductors to larger sizes and the selection of conductor sizes in new construction in growing load situations. First, let us establish criteria briefly stated as follows:

1. Make maximum use of existing facilities.
2. Avoid installations which will result in early obsolescence.
3. Avoid installation which will result in premature investment.

The first is self-explanatory and reasonably definite; whereas the line of demarcation between the other two is somewhat nebulous and more subject to interpretation. Since it appears that load growth will be continuing, it would appear appropriate to take some calculated risk in selections, which would result in moderate premature investment, in preference to attempting close adherence to the dividing line.

Mr Gray's cost curves indicate the total annual cost per mile of feeder for each conductor size under various loading conditions. Now, supposing by use of a load projection curve we substitute years in place of load. If the projection is a straight line the annual cost curves will remain essentially the same in shape and in relation to one another. Should the projection follow a curve other than a straight line, both the shape and relationships of the annual cost curves will be altered, sometimes quite substantially.

Let us assume an existing feeder with 1/0 ACSR conductor. The 15-year load projection indicates that

(*Continued on page* 106)

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All live parts enclosed

The Power Supply Center requires less space, too . . . may be installed immediately adjacent to buildings. It is available in either standard transformer gray or forest green.

Live parts are completely enclosed in weatherproof, tamperproof compartments with padlocking facilities. To protect utility personnel, standard load-center accessories are located inside the low-voltage compartment.

The standard Power Supply Center is built to accommodate primary cable from underground, with either top or bottom cable entrance on the secondary. Optional accessories are also available at additional cost—including provisions for bus duct entrance on the secondary, potheads, lightning arresters, fuses, and provision for the utility's metering equipment. A complete list of accessories is on back of this page.

Low initial cost . . . long-range economy

Initial cost of Power Supply Centers reflects a concentrated effort on the part of Pennsylvania Transformer's engineers and production specialists to provide high-quality standardized units at the lowest cost consistent with realistic business considerations.

For your convenience in ordering or computing costs, prices of standard Power Supply Centers are on the back of this page. Complete information regarding the cost of optional items also is included.

Long-range economies result from the elimination of normal maintenance costs for fences and overhead structures. Also, there is less likelihood of damage from the elements . . . and less chance of service interruptions.

See other side for more details and complete pricing information

PENNSYLVANIA TRANSFORMER DIVISION

McGraw-Edison Company **Canonsburg, Pennsylvania**

FACTS and FIGURES on Pennsylvania's Power Supply Center for shopping centers, industrial plants, schools

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Volts	BIL (kv)			A	B	C	D	E	F		Eastern Zone	Western Zone
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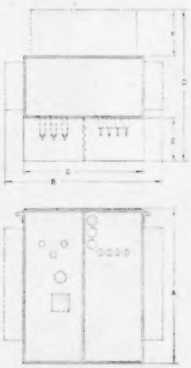
4160	60	480△	1000	94½	92	74 5/16	62⅜	20	22 11/16	12,800	6,605	6,803
4800	60	600△	1500	100½	100	79 5/16	62⅜	20	26 11/16	16,200	8,800	9,064
6900	75		2000	110½	105	85 5/16	67⅜	20	30 11/16	19,700	10,710	11,031
7200	75		2500	125½	116	90 5/16	70⅜	20	34 11/16	24,800	12,157	12,521
12000	95											
13200	95	208Y/120	750	89½	80	70 5/16	58⅜	20	18 11/16	10,800	6,030	6,210
13800	95		1000	100½	92	74 5/16	62⅜	20	22 11/16	13,800	7,050	7,262



*Standard taps—2 above and 2 below

†Freight allowed to railroad siding nearest destination.

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Prices quoted above include isolated high- and low-voltage terminal compartments, with hinged doors . . . provisions for cable entrance . . . and load center transformer (55C rise, standard impedance, oil-immersed) with the following accessories:

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- 4 low-voltage bushings (1.2 kv)
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- Welded-on cover
- Tap changer for de-energized operation (with provision for padlocking)
- Lift lugs
- Liquid-level gauge
- Dial-type thermometer
- Pressure-vacuum gauge
- Welded-on handhole cover
- Filter press connection
- Drain and bottom filter valve with side sampling device
- Formed base with provision for jacking, skidding, rolling
- Connection diagram nameplate
- Stainless-steel ground pad

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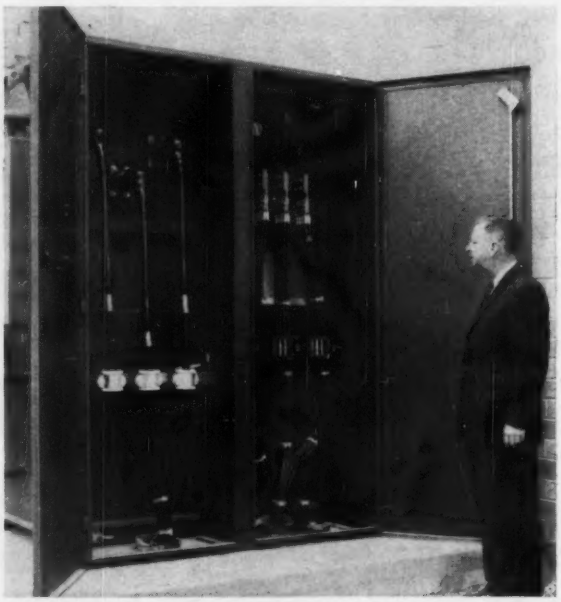
Fuses (3 SM4, with S&C Loadbuster feature).....$600
Potheads (1 3-conductor or 3 1-conductor).....$320
Lightning arresters (set of 3).....3 kv, $70; 6 kv, $100; 9 kv, $135; 12 kv, $165; 15 kv, $225
Provisions only for lightning arresters.....3 or 6 kv, $25; 9, 12 or 15 kv, $40

Low Voltage:

Provision for bus duct connection.....1600 amps., $405; 2000 amps., $635; 3000 amps., $1060; 4000 amps., $1425
Provision for mounting utility's metering transformers.$150



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<<<*Turn to preceding page for complete picture of Power Supply Center's advantages*

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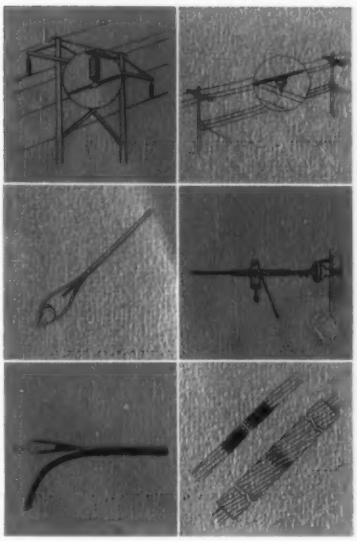

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Electrical World

NOVEMBER 13, 1961
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LATE NEWS ▸

Upper Colorado River Commission's special engineering committee will have the cooperation of the Department of the Interior in making further studies of the project's transmission lines, says Interior Undersecretary James Carr. The engineering committee, trying to plan so that maximum revenue will be available to the Colorado Basin Reclamation Fund, is expected to report early next year.

Two power reactors—the 75-Mw unit of Consumers Public Power District at Hallam, Neb., and the 40-Mw unit of Philadelphia Electric Co at Peach Bottom, Pa., get clearance from the AEC Advisory Committee on Reactor Safeguards. The committee tells AEC that dry critical and excess fuel loading tests can be made safely at Hallam and that Peach Bottom can be constructed and operated safely.

The nuclear section of the European Economic Community (Common Market) considers first proposals for coordination of energy policies and reaches tentative conclusion that nuclear energy should become competitive before 1970. Section, meeting at Stresa, Italy, expects that fixed charges, fuel and management expenses will undoubtedly continue to diminish rapidly.

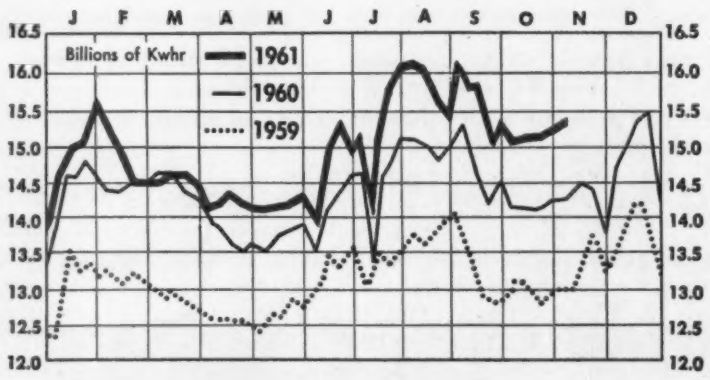
A rate increase for power from three Tennessee Valley dams is recommended to President Kennedy by Comptroller General Joseph Campbell. Wolf Creek, Center Hill and Dale Hollow Dams, built by the Corps of Engineers and operated by Southeastern Power Administration, have their entire output sold to TVA. Campbell says that the General Accounting Office believes that Section 5 of the Flood Control Act of 1944 "clearly imposes a responsibility on the Secretary of the Interior to obtain FPC confirmation and approval of rate schedules for power generated at Corps of Engineers Projects."

Charles K. Rieger is named vice president and group executive of General Electric Co's electric utility group. He succeeds Clarence H. Linder, who will retire in January, 1963, in line with long-standing personal plans. Until his retirement, Linder will serve as vice president and consultant to Rieger to assure an orderly transition. Donald C. Craig, general manager of the company's meter department, is named general manager of GE's turbine division, a post also held by Linder.

Technical feasibility of burning coal slurry as received from a pipeline, without drying, is demonstrated at Werner station of Jersey Central Power & Light. The 70% slurry is burned in an unmodified B&W Cyclone furnace.

WEEKLY POWER OUTPUT—Up 7.1%

(Week ending Nov. 4), Kwhr 15,396,000,000



Percent Change From Previous Year

	Oct. 21	Oct. 28	Nov. 4
Total U.S.	+ 6.8	+ 7.0	+ 7.1
New Eng.	+ 9.1	+ 9.1	+ 7.8
Mid. Atlan. ...	+ 6.9	+ 5.7	+ 7.1
Cent. Indust...	+ 6.8	+ 6.9	+ 5.7
West. Cent. ...	+ 6.2	+ 7.1	+ 7.1
Southeast	+ 4.0	+ 2.8	+ 3.1
South Cent. ..	+ 6.2	+ 8.5	+14.5
Rocky Mount..	+11.1	+14.9	+13.3
Pacific			
NW	+ 5.1	+11.1	+ 8.3
SW	+13.9	+10.9	+11.2

Seasonally Adjusted Index 299

Week Ago 299 Year Ago 278

Source: Edison Electric Institute

Supply Lines

"LEARN TO LIVE WITH GOVERNMENT:" CRESAP

The president of Westinghouse Electric Corp urged businessmen to stop carping about the federal government's growing influence in the economy and put more effort into learning to live with it.

"Like it or not, businessmen must accept the fact that government influence in our economy is not likely to decline and that the best interest of all concerned calls for business and government alike to work constructively within the new framework," said Mark W. Cresap, Jr, in a speech in Washington, D. C.

The emergence of large corporations, which Cresap described as a "pragmatic answer" to meet the needs of the nation, has ended the "Jeffersonian concept" of economics in which business was conducted by many small owner-managers. And along with this change has come an increase in business' responsibility. "Private enterprise certainly is no longer private," Cresap said.

It is thus inevitable that government would assume a larger influence in business affairs, and Cresap added, "There is little doubt that such interdependence will tend to become greater."

In connection with this, the Westinghouse executive discounted the idea that the government is "anti-business." "Before a businessman assumes that Washington is anti-business, he should reflect a moment," Cresap said. "Is he thinking of the President, or of a cabinet member, a department, a minor bureau or an individual?"

Actually, problems which are of importance to businessmen are likewise of vital concern to the government. Faster economic growth, curbs on inflation, scientific and technological breakthroughs, the national defense, the need for rise in living standards all over the world—"all these are common problems and common objectives of industry and government," Cresap said.

Getting more specific, Cresap said he did not believe that the government's string of antitrust cases against his own industry should be cited as an example of an anti-business attitude. "Although it is somewhat painful for me to say, I believe, and I am quite well-equipped to comment on this matter, that the government as a whole, and the government agencies in question, were carrying out in these cases the responsibilities assigned them by the law. And I do not believe that careful and responsible enforcement of the antitrust laws should subject the government to attack from business."

It is up to political leaders to make sure antitrust enforcement is fair, he continued, but it is likewise the responsibility of the business community to obey the laws.

Government must recognize that there are forms of bigness which do not involve the dangers of monopoly, Cresap said. "Bigness becomes a problem of public policy only when it approaches a monopoly position, or when its economic power is used unfairly against the rights and interests of others. . . . The government should maintain a rule of reason which permits such large units to survive and prosper and render still greater service to the people."

Cresap said: "As I look at some of the alleged grievances which are said to be hampering government-business relations today, I do not believe that hostility is justified on either side. And as I weigh the alleged sources of friction . . . at a time of threatened emergency, the supposed irritations become pale indeed."

PENNSYLVANIA PUC TO APPEAL RULING

An appeal of a court ruling barring it from intervention in price-fixing damage suits against electrical manufacturers is planned by the Pennsylvania Public Utility Commission. US District Court Judge William H. Kirkpatrick, who rejected the PUC's intervention request, cleared the way for the appeal by saying the denial order involves a "controlling question of law" that an appeal might clarify. The appeal will be filed in the US Third Circuit Court of Appeals in Philadelphia.

Since Pennsylvania's PUC is the first regulatory agency to file for intervention, the outcome of the appeal could set the precedent for actions of others.

In the State of Washington, other antitrust damage suit actions were taking place last week. Chelan County PUD started taking depositions from officers, employees and former employees of General Electric, Westinghouse, and Allis-Chalmers. It is preparing a damage suit involving an alleged $8 million overcharge from price fixing. Triple damages bring the amount to $24 million.

Douglas County PUD decided to withdraw from participation with the Washington State Attorney General's office in antitrust suits. Reason given: Other big PUD's withdrew, leaving too much of the cost burden on Douglas. District officials believe the amount they would seek to recover is about $300,000.

SANGAMO, GE ANNOUNCE PRICE ADJUSTMENTS

Published prices of General Electric power capacitor equipments have been revised ". . . in accordance with its policy of adjusting its published prices to the market level." Changes effective October 25, and as follows:

Stack Racks

With 50-kvar Units $2.24 per kvar No change
With 100-kvar units from $2.24 to $2.20 per kvar

Switched Pole Top Equipment, 50's			Switched Pole Top Equipment, 100's		
	From	To		From	To
300 Kvar	$ 999	$ 997.98	300 Kvar	$ 999	$ 991.98
450 Kvar	1295	1293.97	600 Kvar	1591	1581.96
600 Kvar	1591	1589.96	900 Kvar	2182	2171.94
900 Kvar	2182	2181.94	1200 Kvar	2773	2761.92
1200 Kvar	2773	2773.92	1500 Kvar	3365	3351.90

To price unswitched equipments subtract $328 per equipment

A General Electric Co spokesman advised that its selling price of the 50 kvar capacitor remains at $97.33 and the selling price for the 100 kvar capacitor remains at $194.66.

Sangamo Electric Co has adjusted instrument transformer list prices to utilize a 40% discount for electric utilities. Effect of the change is a slight lowering of prices on most items. The reduction varies from a few cents to about 1%. Prices on a few low-volume transformers are increased. Credits will be issued for overcharges on orders shipped since October 2, but no debits will be issued for undercharges on orders since that date.

PUBLIC SERVICE CO. OF COLORADO uses pole-mounted electronically controlled L-M reclosers to protect all main feeder distribution lines. Here an L-M Type WE recloser protects a 9000 kva, 7,620/13,200 grounded wye feeder in a suburban location, supplying a combination residential, commercial and industrial load.

Public Service of Colorado Simplifies Protection With L-M Electronic Reclosers

Several years ago, engineers at Public Service Company of Colorado developed a plan to simplify the application of protection to 7.6/13.2 kv distribution feeders. This simplification is employed on both new loads and conversion of overloaded 4 kv areas, and involves the use of heavy duty single-phase and 3-phase reclosers and sectionalizers.

Main feeders of 6000 to 9000 kva supply power to distribution laterals. These lateral circuits constitute most of the exposure of the feeders and are subjected to the majority of the faults. Standardized L-M reclosers, sectionalizers, and cutouts protect these lateral lines.

The introduction of L-M Type WE and Type RE reclosers with electronic control has added a new dimension for PSCo. of Colorado to the simplification of protective equipment application. With these pole-mounted three-phase reclosers, load increases and necessary protection changes can be made with maximum flexibility. Minimum phase trip and ground trip current ratings can be changed by simply replacing present cartridge with a new cartridge of desired rating as the load grows.

No down time for untanking or relay changing is necessary. L-M electronic Type WE and RE reclosers provide greater flexibility, greater accuracy, and greater accessibility than do other reclosers or OCB's.

Get complete details from your L-M Field Engineer on how your system protection can be simplified, at a cost lower than other comparable protective devices. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13, Canada.

L-M TYPE RE RECLOSER with electronic control can be easily installed in substation or on pole top. Here the control cabinet is conveniently located at the bottom of the pole. Connection between recloser and control is made by a plug-in control cable.

LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

543 *Reclosers, Sectionalizers, and Oil Switches*

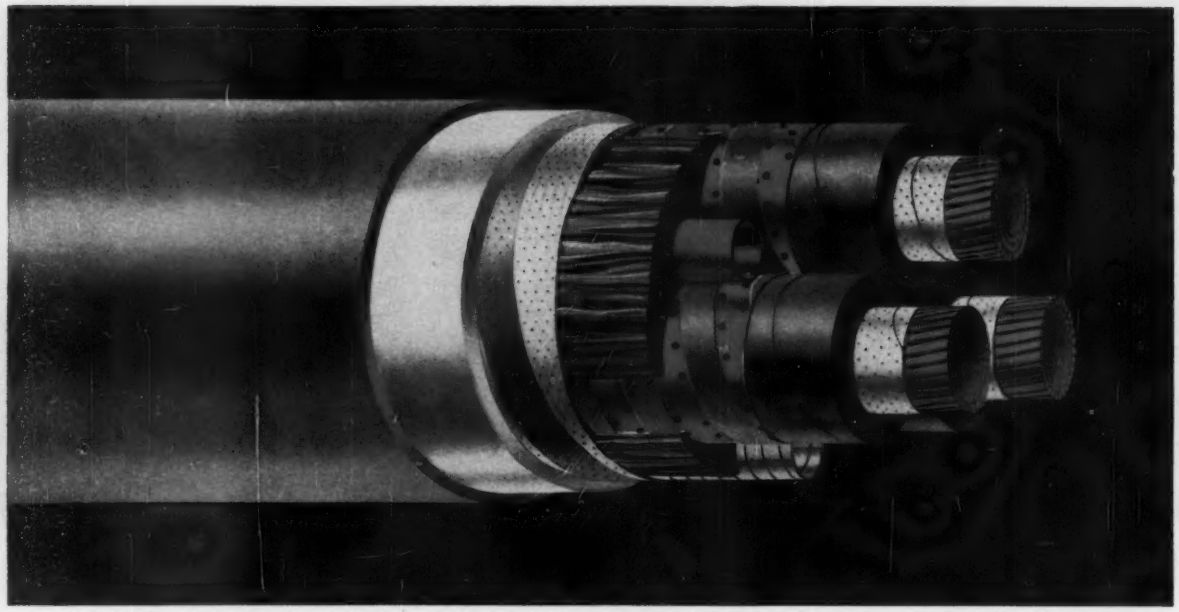
McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

DEVELOPED BY PHELPS DODGE FOR THE ELECTRIC UTILITY INDUSTRY

New 69 KV High-Pressure, Gas-Filled Aluminum Sheath Aerial Cable

Provides Practical, Economical Design for Increasing Transmission Requirements in Congested Areas

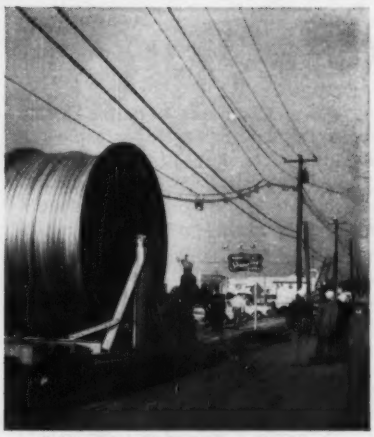


CABLE SPECIFICATION

Voltage	69 Kv.
Rating	75 MVA
Ambient air temperature	25°C
Conductor temperature, normal	75°C
emergency	90°C
Nominal shipping length	1000 ft.
Cable construction	
Three compact round conductors	800 MCM
Graded 1 to 6 mil wood pulp paper insulation	315 mils
Two steel spiral gas channels O.D.	0.760"
One copper tube gas channel O.D.	0.625"
Seamless tubular aluminum sheath	180 mils
Extruded high density polyethylene jacket	125 mils
Overall diameter	4.15 in.
Nominal operating pressure	200 psig.
Joints	Mechanical
Potheads	HPG type
Gas supply	Central Gas Cabinet

TESTING SPECIFICATION

Power factor at 90°C	below 1.0%
Ionization factor	Minimum
Sixty cycle voltage tests to ground	
Full reel	47 Kv.
Sample withstand tests,	
6 hour	107 Kv.
one minute	175 Kv.
Impulse withstand voltage test to ground (1½ x 40)	
Cable and splice	350 Kv.
Load cycle test, 60 Kv. to ground, 100°C copper	Stable



Cable was installed using aluminum blocks supplemented by periodic placement of steel blocks for mechanical strength. 69 KV cable was pulled into position from reel on trailer to messenger.

Phelps Dodge has designed and fabricated a versatile new three-conductor 69 KV aerial cable system for Long Island Lighting Co. specifically engineered for its rapidly growing suburban areas. This aluminum sheathed paper insulated high voltage power cable may be installed on distribution poles and offers the advantage of aerial cable performance at a cost substantially lower than equivalent underground cable systems. In communities with steady population and industrial growth, it meets a current need for transmitting increased electric power at high voltages where open wire systems cannot be installed.

The entire circuit includes 10,000 feet of aerially installed cable and 3000 feet of directly buried underground cable. All directly buried underground cable was provided with a high density polyethylene jacket for both mechanical and corrosion protection. Mechanical joint sleeves, developed and introduced by Phelps Dodge for use with aluminum-sheathed cable, together with installation techniques that assure dependable cable performance, were used in this LILCO project.

Other features of this advanced aerial cable are its relatively light weight and small diameter for its voltage and rating. A simple pressure control system maintains the nitrogen gas at a nominal 200-pound pressure.

The first aluminum sheathed aerial power cable installed in the United States was designed and fabricated by Phelps Dodge in 1953. Over the past years, this type cable has gained increased acceptance with utilities as an economical and practical answer to special transmission problems.

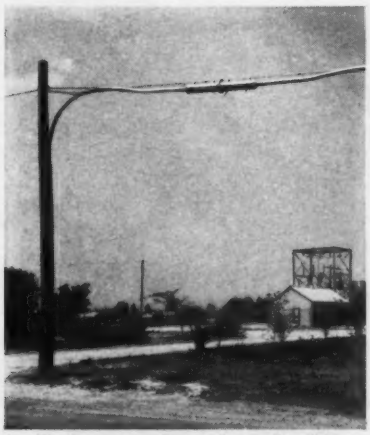
Pressurized aluminum sheathed aerial cable was first installed in this country in 1957. During that same year, design was begun on the cable system which is described here. Phelps Dodge can furnish aluminum sheathed power cable systems within a wide range of higher voltage ratings, and has designed and fabricated a 345 KV cable of this type with a capacity of 500 MVA.

For further information and engineering assistance on your particular problems, contact your local Phelps Dodge representative.

Underground portion of cable is shown in trench for direct burial. A section of underground portion was drawn thru a steel sleeve which had been driven under a heavily traveled parkway. An extruded high density polyethylene sheath was applied over aluminum sheath for mechanical and corrosion protection of underground sections.

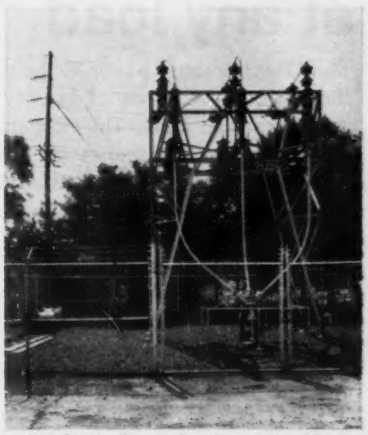
PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 Park Avenue, New York 22, N.Y.

MINE TO MARKET

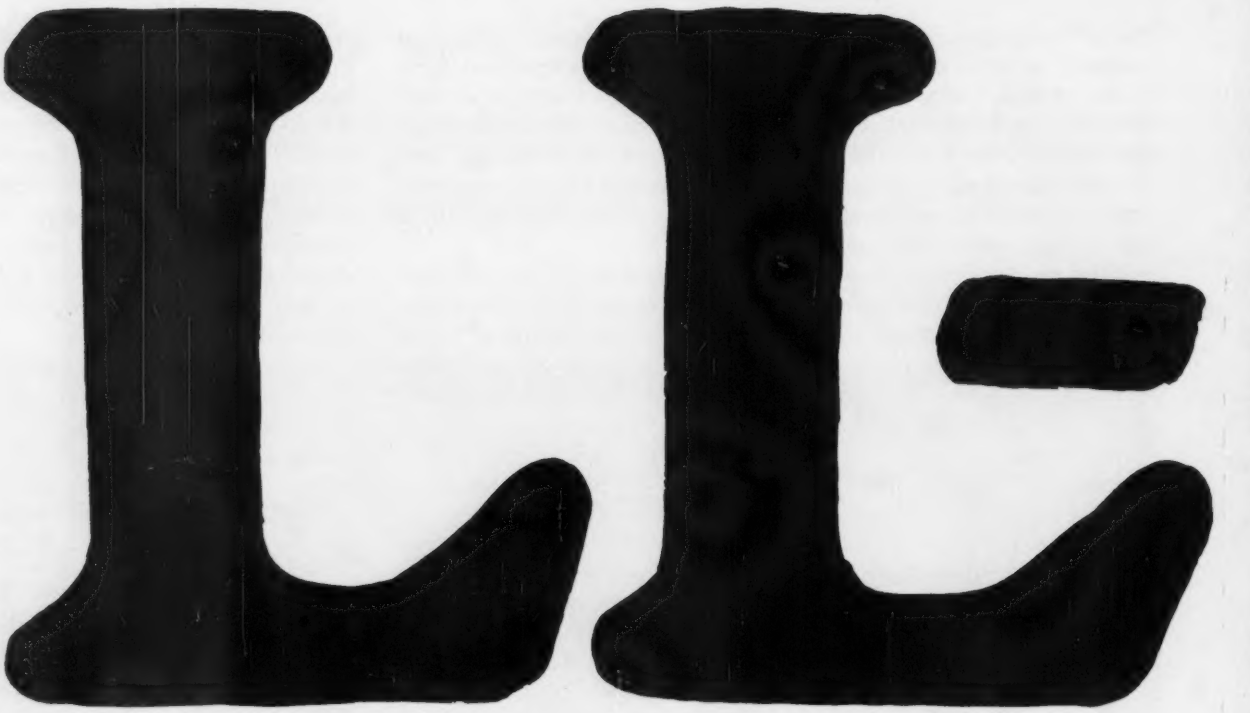


Underground section of cable emerges from ground in a specially designed ventilated riser, spliced to aerial section. Note neat appearance of cable, including normal joint.

At local intersection, 69 KV cable shares poles with telephone cables, secondary and 13 KV primary. Use of aluminum sheath aerial cable overcomes objections to overhead open wire systems in communities.



Mechanical termination assembly showing both aerial and underground terminations of cable system. Termination assembly, an above ground spreader type, is fabricated completely of aluminum.



delivers more payload at any load

The Westinghouse LL-65 is the new way to reduce distribution costs. Tomorrow or twenty years from now. It saves you money on losses the first day you put it up. It saves you a large *total* of money over its life. No matter what size you use, no matter how you load it, *it saves you money.*

The LL-65 reduces service interruptions due to voltage complaints. It goes years longer before changeout. It has a 10% to 15% lower evaluated operating cost than the old 55° unit—and without increase in first cost.

For complete information or a specific transformer evaluation, contact your Westinghouse sales engineer or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. *You can be sure . . . if it's Westinghouse.*

Same thermal performance—a 15 kva unit can carry 30 kva with normal life expectancy, or 33 kva on an emergency basis.

Improved voltage performance—reduced impedances may delay capital expenditures due to voltage complaints from 1 to 5 years.

Improved economic performance—significantly reduced copper and iron losses reduce total costs, improve voltage conditions.

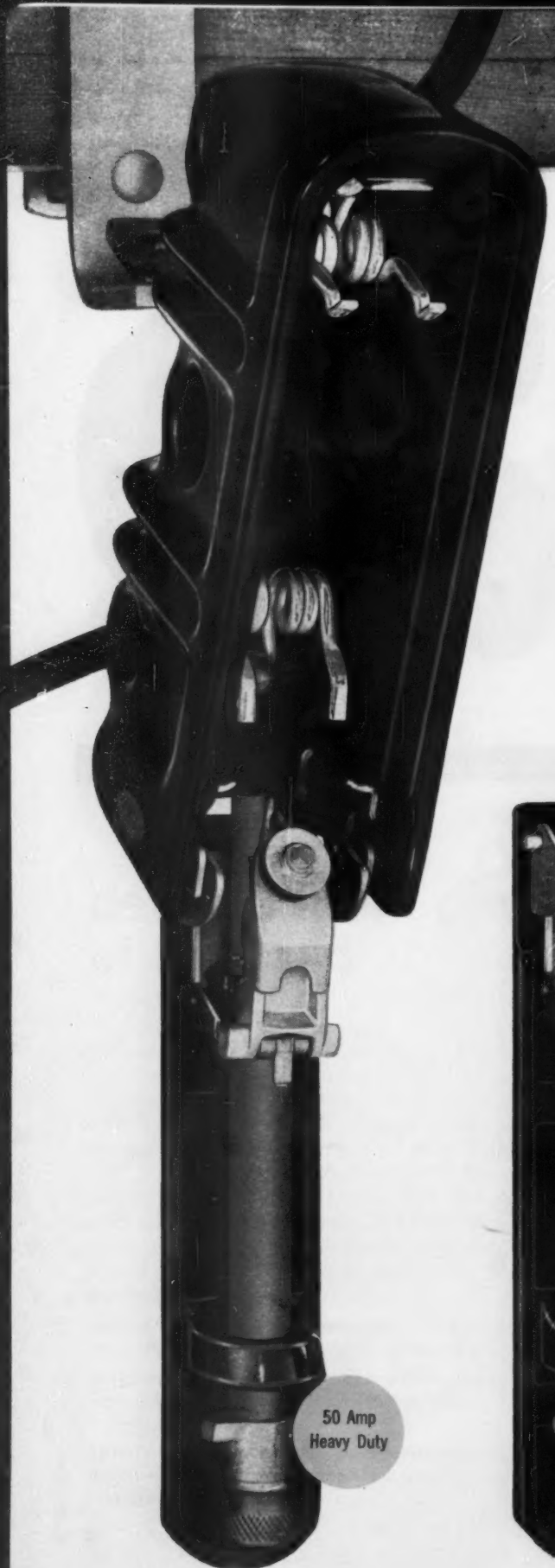
J-70960

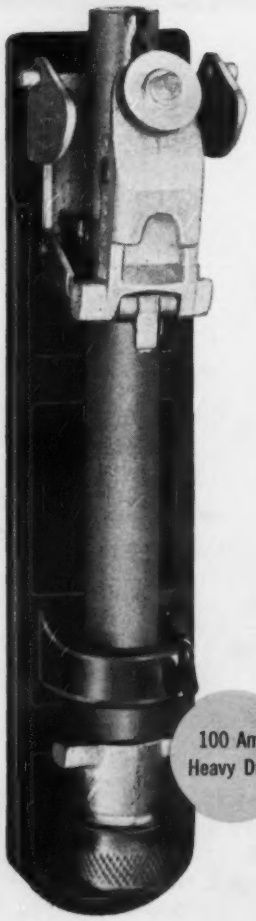
Westinghouse

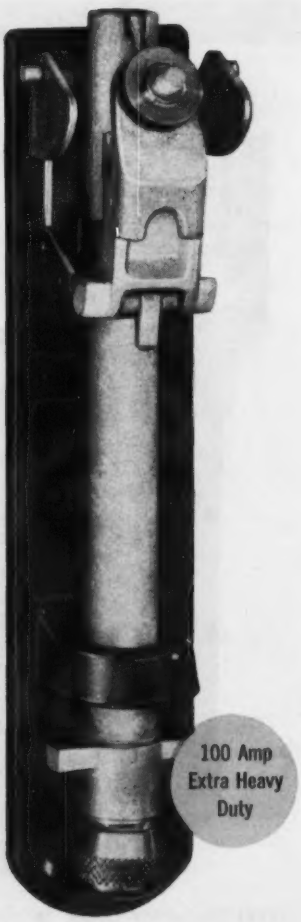
65

KEARNEY PACE WITH

	Cutout Rating		Type	Interrupting Rating RMS Asymetrical Amperes			Cat. No.
	Volts	Amps		2.6 KV	5.2 KV	7.8 KV	
HD	5200	50	Indicating Non-Indicating	8000	5000		49409
HD	5200	100	Indicating Non-Indicating	8000	5000		49410
EHD	5200	100	Indicating Non-Indicating	14,000	10,000		49411
	5200	200	Dead Blade Disconnect				49410-200
HD	7800	50	Indicating Non-Indicating	8000	5000	4000	49412
HD	7800	100	Indicating Non-Indicating	8000	5000	4000	49413
EHD	7800	100	Indicating Non-Indicating	14,000	10,000	8000	49414
	7800	200	Dead Blade Disconnect				49413-200







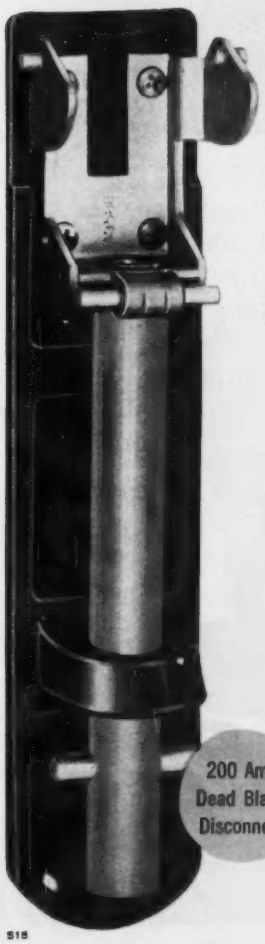
ENCLOSED CUTOUTS KEEP EXPANDING SYSTEM NEEDS!

...can be inexpensively uprated any time in the future...by simply changing doors

Kearney Enclosed Cutouts provide an ideal solution to a perplexing, two-fold problem faced by many power systems today:

First, that of specifying low-cost, dependable fault protection fully adequate for present needs, yet adaptable enough to comply with the future requirements of a rapidly expanding system... and second, that of uprating to the levels of future system demands without incurring exhorbitant and unnecessary costs of usable product obsolescence.

In addition to their low first cost, Kearney Enclosed Cutouts give greater long-range value for every cutout dollar... because they can be quickly and inexpensively uprated in continuous ampere rating, interrupting rating, or both, by simply changing doors... whenever expanding system requirements make it necessary. Each of two porcelain boxes accepts four interchangeable door assemblies and provide adequate interrupting capacities to meet any future needs up to 8,000 amperes at 7.8 KV, 10,000 amperes at 5.2 KV and 14,000 amperes at 2.6 KV.



Buy now and plan ahead for the future. By specifying Kearney Enclosed Cutouts now, you can minimize inventories, reduce ultimate maintenance costs, eliminate the high cost of later removal and replacement of entire units... and be prepared to meet future system demands for dependable fault protection.

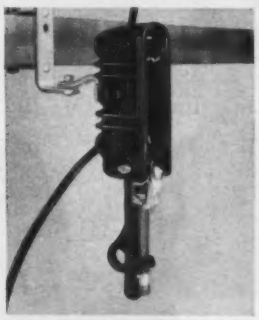
Important Design Improvements...

Economy, higher interrupting capacities and interchangeability of doors have been achieved with no increase in price or sacrifice of high quality. Improved lower trunnion construction permits entire recoil thrust to be absorbed by the trunnion, porcelain box and a heavy duty hanger rather than by the upper contacts; thus high pressure low-resistance contact is maintained during each interruption and throughout the service life of the cutout. Heavy duty hangers are standard equipment on all Kearney Enclosed Cutouts, to adapt the cutout to future system requirements.

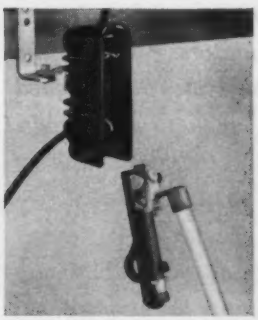
A highly efficient spring flipper whips fuse link cable out of cartridge, assures positive low fault interruption. Re-fusing is simple, foolproof... cartridge locks in position even if lineman fails to snub fuse link leader tight ... contact pressure cannot change.

Lengthened cartridge tube projects slightly below the box to prevent any deflection of ionized gas which might cause internal flashover.

Plated, box-type terminals accommodate up to 4/0 stranded copper and aluminum conductor. All current carrying parts are non-ferrous. Duronze hinge pins, silver-to-silver contacts. Bolt-thru construction of contacts, brackets and terminals... parts cannot loosen or pull out of housing.



Doors drop out to full 180° angle in the indicating position.



Doors may be easily removed or inserted from any angle with standard hookstick.

Easily converted to non-indicating by inserting only one screw.

For complete information contact your Kearney Sales Representative

for better construction... safer maintenance... specify KEARNEY products

KEARNEY

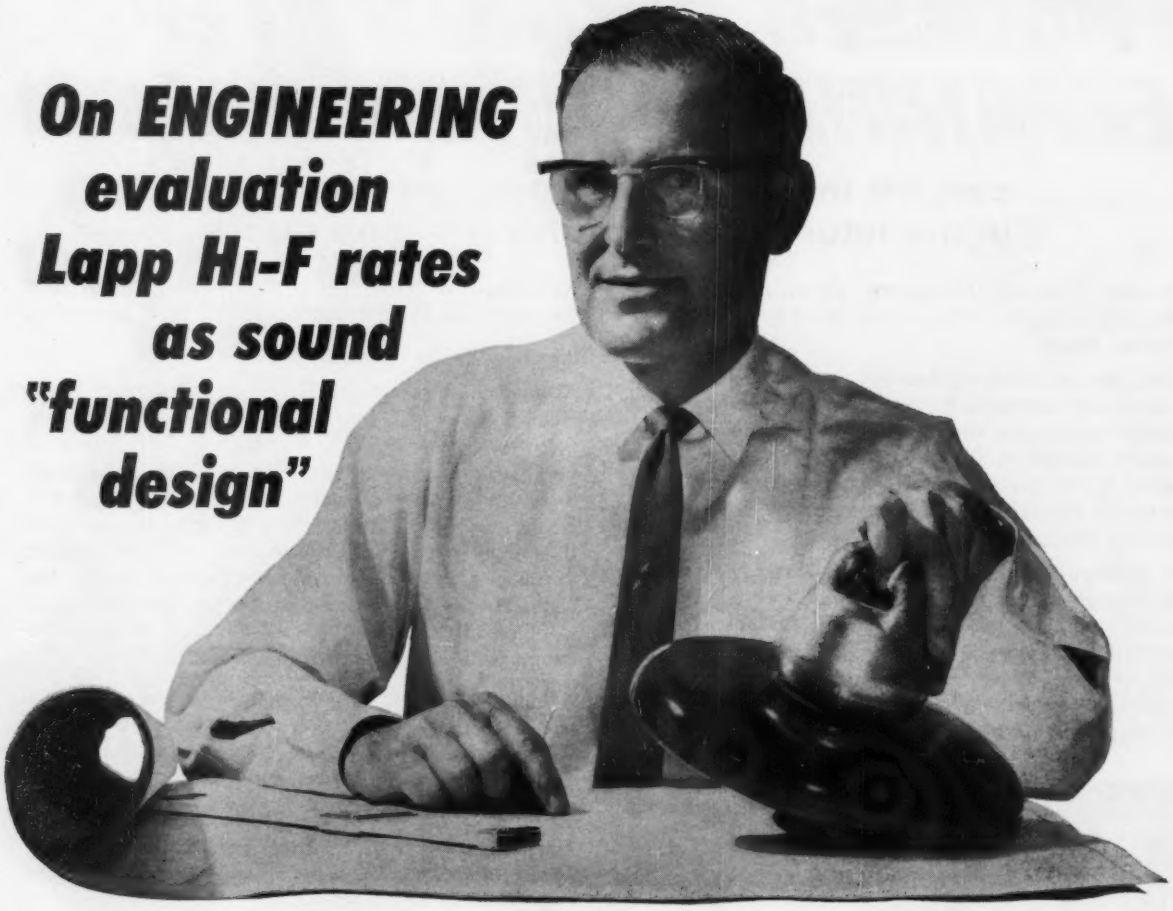
JAMES R. KEARNEY CORPORATION

4224-42 Clayton Avenue • St. Louis 10, Missouri

PLANTS AT: ST. LOUIS • MELROSE PARK, ILLINOIS • FAYETTEVILLE, ARKANSAS • GUELPH, ONTARIO, CANADA • ST. THERESE, QUEBEC, CANADA

515

On ENGINEERING evaluation Lapp Hi-F rates as sound "functional design"



"In engineering, we don't think there's much more sense to over-design than there is in under-design. We rate as "most efficient" that transmission line design that comes closest to matching up the strength characteristics of conductor, structure, hardware and insulators.

"Most of our transmission system is designed for a working load of only a few thousand pounds. Lapp **Hi-F**, *with an M&E strength rating of 14,000 lbs., is an up-to-date 'compact model' suspension insulator. Because it satisfies our engineering requirements, and saves the company money, it goes on our standards list pronto!"*

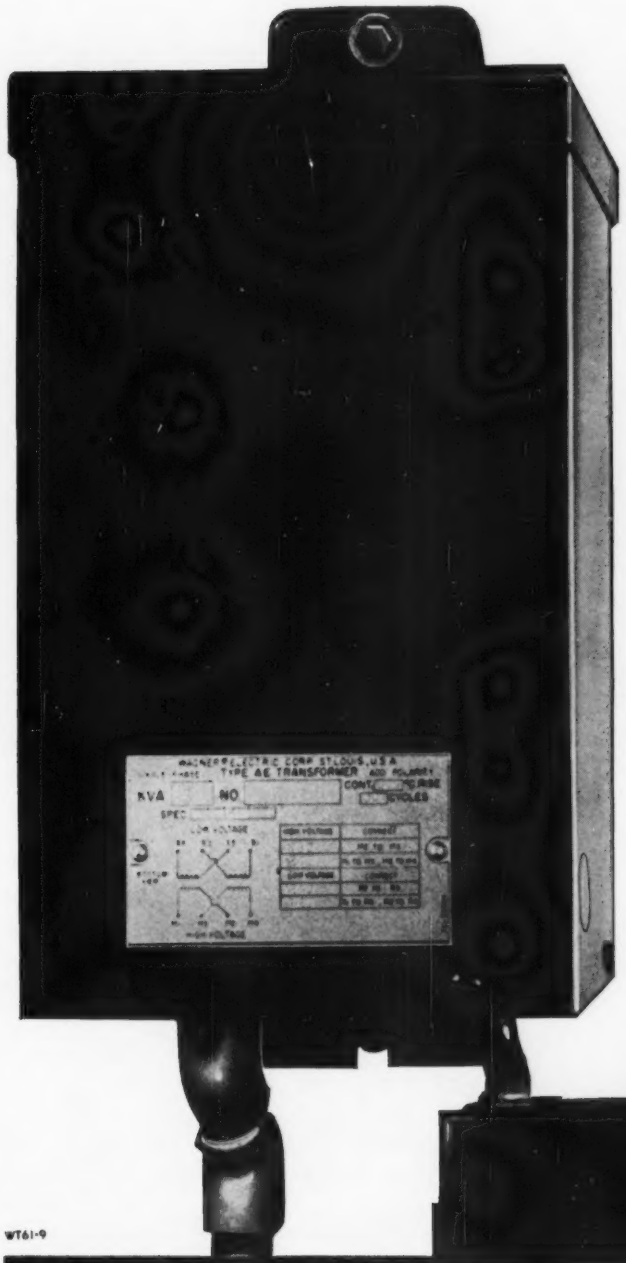
There's no compromise with quality in Lapp Hi-F—only a reduction in size and weight (and a more realistic relationship between rated strength values and actual performance characteristics). As compared with the NEMA standard 10" suspension insulator, Lapp Hi-F is 1" smaller in diameter, one-third less in weight, and is fully interchangeable physically. Rated at 14,000 lbs. M&E strength, Hi-F matches EEI-NEMA-52-3 in every other mechanical rating, and in every electrical characteristic. On every consideration, technical or economic, we think you too will rate Lapp Hi-F as "OK."

Lapp Insulator Co., Inc., LeRoy, N. Y.

WAGNER® DRY-TYPE GENERAL PURPOSE TRANSFORMERS

Compact Epoxy-Filled Units that

WHISPER WHILE THEY WORK



Unusually small in size (the 10 kva rating is less than a foot-and-a-half high), Wagner® totally-enclosed Type AE Single Phase Transformers can be used for general purpose applications. They have a low sound level, the result of encasing small Wagner Form W core and coils in a solid block of epoxy compound . . . to give you a whisper-quiet transformer that can be used anywhere noise would be a nuisance.

Available in ratings from 1 to 10 kva, Wagner Type AE Transformers have insulation protection suitable for continuous operation at 80°C in a 30°C average ambient. All parts are sealed from dust, moisture, and corrosion by the epoxy compound. Every unit is built to conform to all applicable standards of ASA and NEMA.

Wagner Type AE Transformers can be installed indoors or out in any location where they will not be submerged or exposed to injurious fumes in concentration. Compact and lightweight, they require no fireproof vaults and can be mounted indoors in any position, at any angle, on wall, floor, or ceiling. These transformers are carried in stock at Wagner branches and distributors. There's one near you, listed in your 'phone book. Call or write now.

Wagner Electric Corporation
6456 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

WT61-9

SPECIFICATIONS

Type AE—Single Phase—1 to 10 Kva 80° C Rise, 60 Cycles.

High Voltages: 120 x 240; 240 x 480; 600 volts, no taps; 480, 600 volts, 2—5% taps below normal.

Low Voltage: 120/240 volts.

KVA	DIMENSIONS IN INCHES			NET WEIGHT POUNDS	AVERAGE SOUND LEVEL DECIBELS
	Height	Width	Depth		
1	10 13/16	6 5/16	6 3/16	28	37
1½	11 13/16	6 5/16	6 3/16	34	38
2	13 1/8	6 13/16	7 3/16	46	38
3	14 1/8	6 13/16	7 3/16	62	39
5	15 5/16	9 3/4	9 1/4	93	39
7½	16 1/16	9 11/16	10 7/16	130	39
10	17 1/8	11 1/8	10 1/4	167	39

Plants grow better beside water

That's because an abundance of water is necessary for plant life. And those that have their roots at the water's edge can devote full attention to the problems of productivity.

Since 1953, more than 3,000 new plants have located on the Mississippi River System alone, not to mention the Great Lakes, the Gulf and numerous other rivers. Why? Mostly it is a matter of the "cost of living." Process water and plant utilities can be obtained economically; raw materials and finished products can be moved in and out at low cost.

If you are considering a waterside location, or plan to expand or modernize an existing plant, you are invited to call on Dravo's 60 years' experience in and around water. Work has been performed for the U.S. Army Corps of Engineers in every one of the past 60 years, including many lock and dam projects in the continuing program for improvement of the country's inland waterways system. Another activity is production and marketing of river sand and gravel. Hundreds of industrial plants are served by Dravo-built docks. Ships and barges laden with ore, coal, bauxite and other bulk cargo are unloaded by Dravo materials handling equipment.

Pumphouses and water intakes, water and waste treatment facilities, steam or power generating plants, fabricated piping are also company specialties. Towboats, tugboats and barges launched at the Pittsburgh or Wilmington shipyards move almost every type of water-borne commodity. A subsidiary, Union Barge Line, offers common-carrier and contract transportation service on the Mississippi River System and Gulf Intracoastal Waterway.

The coupon can be used to obtain more information on these activities.

Marine construction experience includes giant dam and lock projects—commercial installations of all kinds.

Twin high-speed river towboats built for a New Orleans transportation company.

A Union Barge Line tow carries products of many industries.

Generating station, dock and unloader built on turn-key basis.

A covered hopper barge is launched at Neville Island shipyard.

Dravo Corporation, 4790 Grand Avenue, Pittsburgh 25, Pa.

Please send me information on the following products and services:

- ☐ Pumping Stations & Intakes
- ☐ Sewage & Water Treatment
- ☐ Coal & Ore Unloaders
- ☐ River Transportation
- ☐ Sintering & Pelletizing Plants
- ☐ Docks, Harbors, Foundations
- ☐ Oxygen Steelmaking
- ☐ Ore Bridges
- ☐ Shafts, Slopes
- ☐ Grating
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Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

DRAVO

"A 5% saving in operating cost plus higher resale value is why we're buying Ford Trucks exclusively"

says James Lafferty, Transportation Manager for Henkels & McCoy, Inc., Philadelphia, Pennsylvania

"We ran a six-month comparative test on six Ford Trucks against six equivalent competitive models and found that the Ford Truck operating costs consistently ran 5% less than the others. Also, the increasing popularity of Fords with truck users means that we invariably pick up an extra $100 to $200 at resale time.

"Our company has 441 Ford Trucks operating from one end of the country to the other. Less than 20% of our fleet is within practical traveling distance of our two maintenance depots, so we depend on local Ford Dealers for the bulk of our service work. The complete network of Ford Dealers—even in remotest areas—provides unparalleled service everywhere.

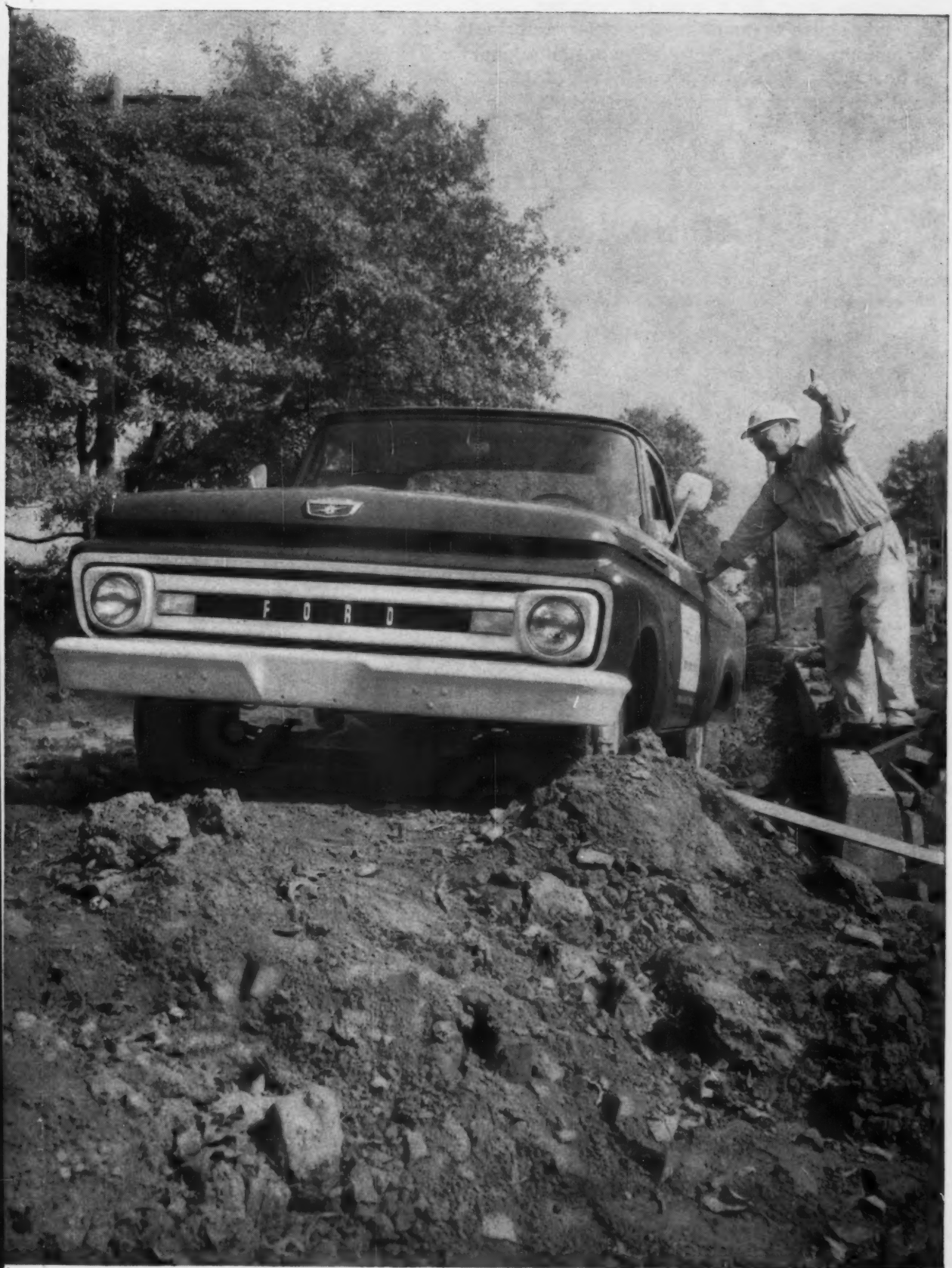
"We specialize in handling construction and maintenance jobs. For example, we maintain utility lines, telephone lines, gas pipelines, and put in city and shopping center lighting systems. On these jobs, our trucks usually have to make their own way, road or no road. We use Ford F-250 4-wheel drive pickups in transporting crews to construction sites and F-600's to handle telephone line or pipeline construction, while our T-750 Tandem Axle trucks are equipped with a boring unit to dig 11-foot-deep holes for powerline transmission poles.

"Ford's rugged dependability, universal adaptability and superior economy keep us buying Ford Trucks exclusively."

Solid testimony that Ford's full-time economy only starts with low price!

FORD TRUCKS COST LESS

PRODUCTS OF Ford MOTOR COMPANY


FORD

Supplying power for a large city involves crucial service to hospitals and other important community buildings. Here is the actual account of how one city protects against loss of this vital service and damage to equipment.

Honeywell's Ultra-Vision* Flame Detector

65 million dollars for the Los Angeles

The new, ultra-modern Scattergood Steam Plant of the Los Angeles Department of Power and Water is on a 57-acre ocean-front site south of the Playa del Rey district of Los Angeles. It cost slightly more than 65 million dollars.

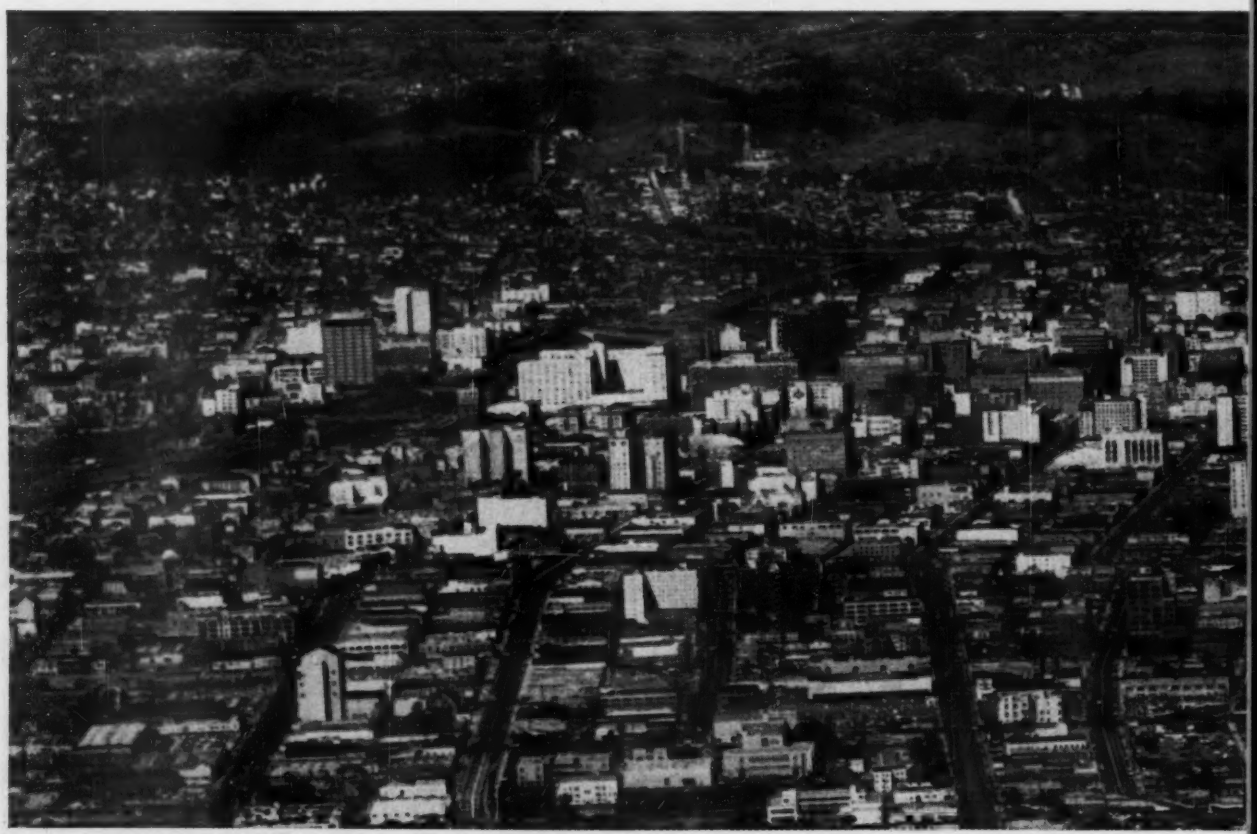
To provide and maintain an efficient and foolproof flame safeguard system for this enormous plant, the designers and engineers of the L.A. Power Department installed Honeywell's new Ultra-Vision Flame Detector and Protectoglo Self-checking Relay.

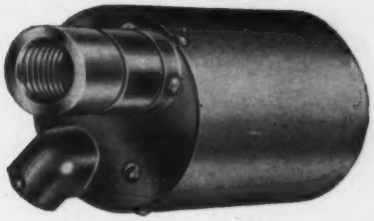
The Scattergood plant is presently producing 320,000 kilowatts from two 91-foot long turbine generators. When the entire complement of six generators is put into operation the anticipated output will be 1,200,000 kilowatts.

Fuel for the 133-foot high boilers at Scattergood is gas, oil or both. *Under full load*, gas consumption is approximately 1,520,000 cubic feet per hour; oil about 250 barrels per hour. Furnace volume is 65,000 cubic feet.

The heart of the flame safeguard system for Scattergood is Honeywell's C7012 Ultra-Vision Flame Detector. The C7012 employs an ultraviolet signal that positively distinguishes between an actual flame (ultraviolet rays) and a hot refractory (infrared rays). It responds only to ultraviolet radiation in the .195 to .206 micron wave band. Because this new control device is not sensitive to a hot refractory, flame supervision of both single and multiple burners is simplified. The Ultra-Vision Flame Detector can be aimed at each individual flame in the most convenient manner.

For the job at Scattergood, the Ultra-Vision Flame Detector is combined with Honeywell's R4075 Protectoglo Self-checking Relay. The R4075 checks its components, not only



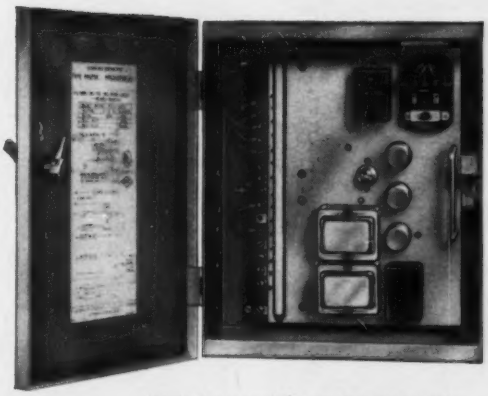


C7012 Ultra-Vision* Flame Detector

watches over Power Company

at startup, but during the entire operating period of the process. A continuously pulsing relay pulls in once every second, making and breaking the flame circuit. If there is a failure of any kind, the pulsing stops and there is an immediate safety shutdown. This Honeywell Flame safeguard system provides the first fail-safe protection for industrial burners.

If you would like full particulars on Honeywell's Flame Safeguard Systems, write to Honeywell, Dept. ET-11-13-61, Minneapolis 8, Minnesota. *Sales and service offices in all principal cities of the world.*



R4075 Protectoglo* Self-Checking Relay

Honeywell

First in Control

SINCE 1885

*Trademark

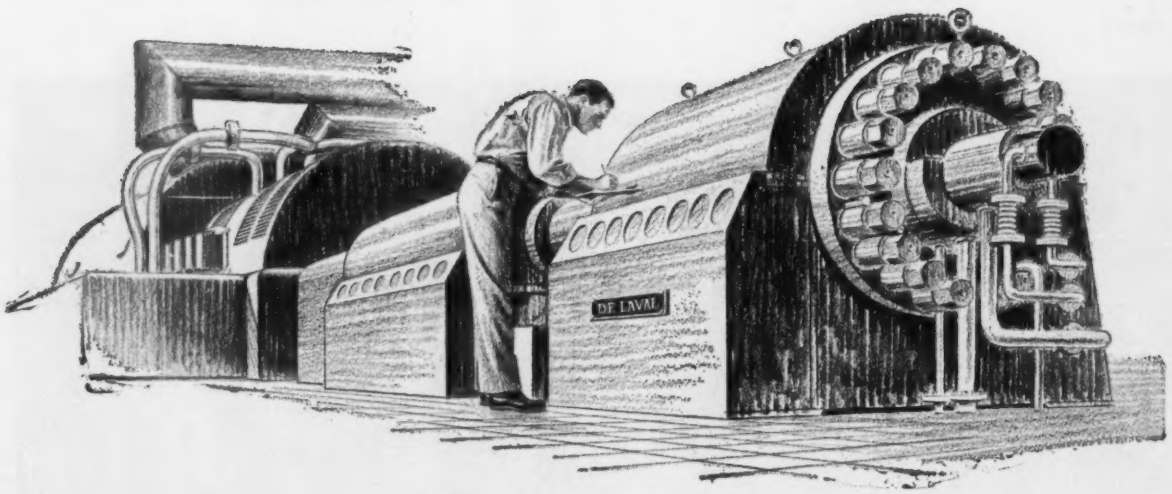
DE LAVAL

engineering ingenuity means low-cost feed for giant boilers

Electricity remains "America's biggest bargain" because of the applied engineering ingenuity of the nation's electric utilities and their suppliers. Case in point: the planned installation of high-capacity De Laval boiler-feed pumps at a prominent utility. For the first time in a U. S. utility, boiler-feed pumps will be driven through the governor end of the main steam turbine-generator. Costly energy-conversion processes will be eliminated; more electricity will be available for sale. The utilities will gain another tool in their continuing effort to hold the line on cost.

Whether you have giant boilers to feed, or other problems involving rotating machinery, De Laval engineering ingenuity can help.

De Laval Steam Turbine Company, Trenton 2, N. J.



MODEL 107

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Type 316

Type 316

story of two bolts...

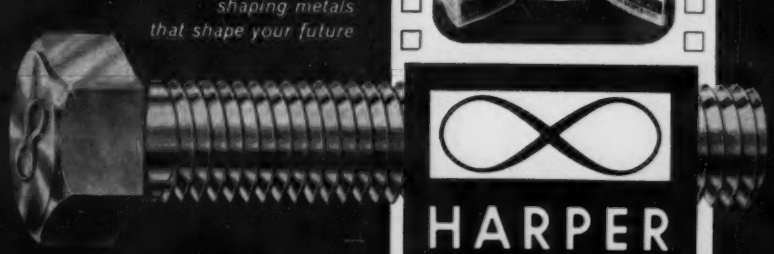
Both of the bolts shown above were used on the *same* application, in the *same* factory, and faced the *same conditions*.

The bolt on the left is a Harper type 316 Stainless Steel bolt shown after three years of service. The bolt on the right is another manufacturer's bolt, identified as type 316 Stainless Steel, shown after only three months of service.

The dramatic fact that the Harper bolt lasted twelve times longer (and is still in service) is proof of Harpers' metallurgical control of alloys from "billet to bolt" in our completely integrated factory. Harper's corrosion-resistant fastenings, immediately available in a wide range of alloys and sizes, assure you that *your* products will be built to last no matter what the application may be.

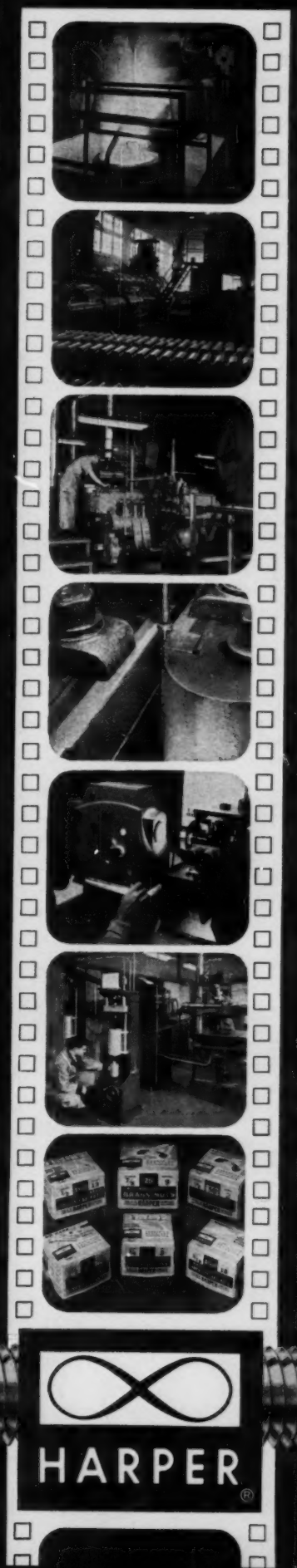
Harper Distributors everywhere maintain complete stocks. Consult your Yellow Pages.

Write today for free copy of Harper's new "Strength" booklet —a factual treatise on important fastening metallurgy.



shaping metals that shape your future

THE H. M. HARPER COMPANY
8200 Lehigh Avenue • Morton Grove, Illinois



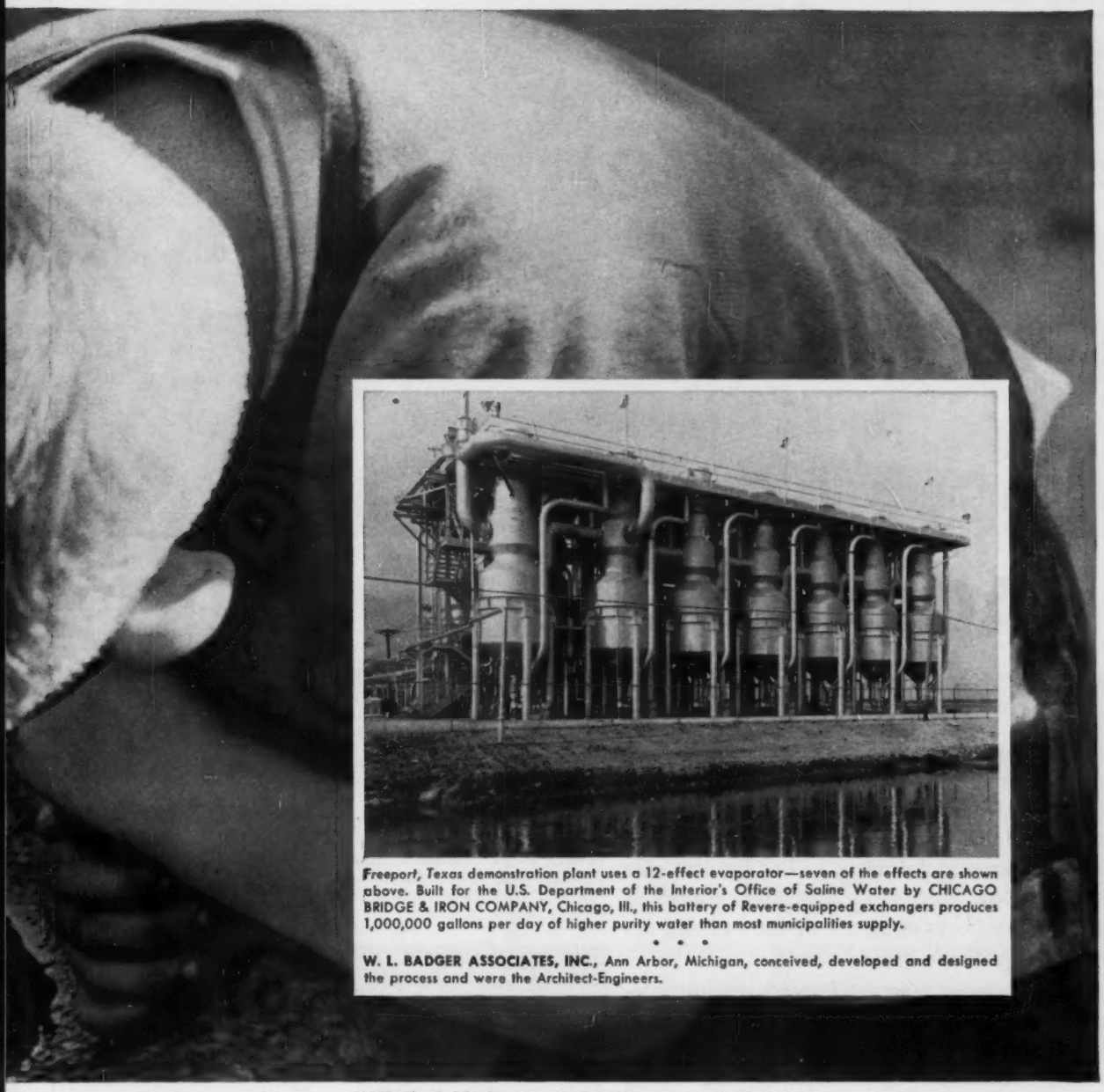
With the Help of 124 Tons of Revere Condenser and Heat Exchanger Tube in Prototype Sea-Water Conversion Plant

Peculiarly, in a world that is more water than land, there's a shortage in many areas of water fit to drink or use. The very presence of this "useless" sea water has long been a challenge to scientists, engineers and governments.

Recently, announcement was made of the first sea water conversion plant in the United States capable of producing 1,000,000 gallons of fresh water per day. It was designed to convert sea water to potable water for man, livestock and for use in irrigation, and was placed on stream experimentally in Freeport, Texas in June 1961, by the Office of Saline Water of the U.S. Department of the Interior.

The unit consists of a 12-effect evaporator that heats the sea water, converts it to steam and manufactures useful water. Here—as wherever heat, pressure and moisture are handled—was another use for Revere Tube.

In one part of the equipment, where the combina-



Freeport, Texas demonstration plant uses a 12-effect evaporator—seven of the effects are shown above. Built for the U.S. Department of the Interior's Office of Saline Water by CHICAGO BRIDGE & IRON COMPANY, Chicago, Ill., this battery of Revere-equipped exchangers produces 1,000,000 gallons per day of higher purity water than most municipalities supply.

• • •

W. L. BADGER ASSOCIATES, INC., Ann Arbor, Michigan, conceived, developed and designed the process and were the Architect-Engineers.

NOTE: Flooded by hurricane Carla — back in operation in 5 days.

tion of briny water, 250 degree temperature and pressure was encountered, *Revere Welded Steel Tube* was recommended. Over 15 miles of it, in fact, in the 12-effect evaporator. But since this was to be a "demonstration" plant, additional Revere Alloys were recommended for test purposes . . . Admiralty, Aluminum Brass and 90/10 Cupro Nickel. Altogether, this Conversion Plant used an amazing 124 tons of Revere Tube!

Why not have the Revere Technical Advisory Service work with you in solving *your* specific problem . . . simply by calling the Revere Office nearest you?

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COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

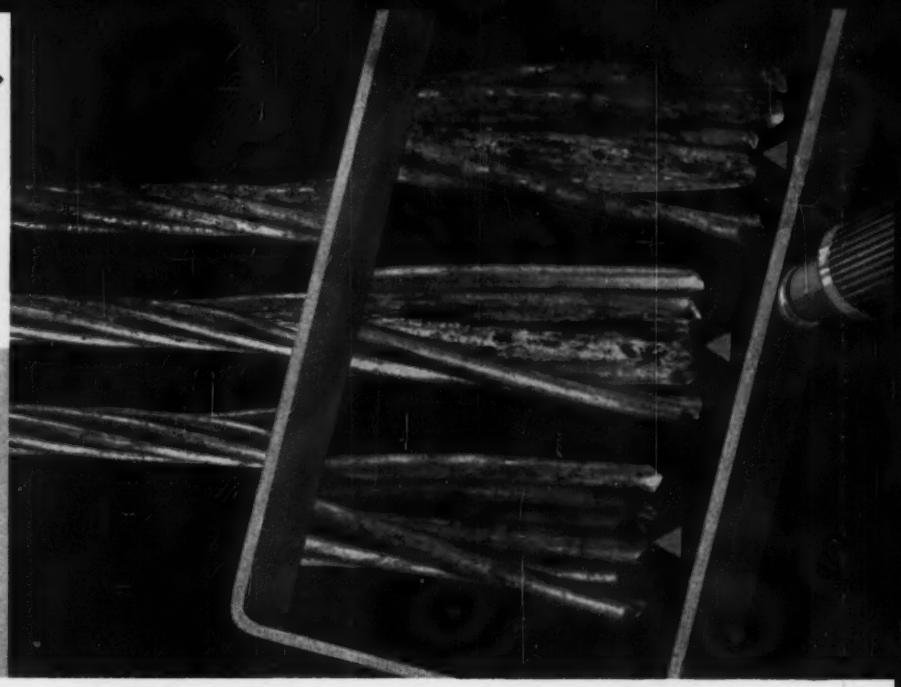
Executive Offices: 230 Park Ave., New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford and Plymouth, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities.

Distributors Everywhere

Integral Finned Tube • Bimetal Tube • Dual Gauge Tube • Instrumentation Tube • Condenser Tubes In Cupro-Nickel, Aluminum Brass, Admiralty, Herculoy (Silicon-Bronze), Arsenical Copper, Muntz Metal And Other Alloys • Aluminum Tube, Sheet And Extrusions • Small And Large Plates In Cupro-Nickel, Copper, Herculoy, Muntz Metal, Naval Brass And Admiralty • Low Carbon Steel Heat Exchanger Tube To ASTM Spec. A-214 And A-334 Grade "C". Boiler Tube, To ASTM Spec. A-178.

• These three specimens of 6/1 ACSR were removed from a West Coast test site where they were exposed to a severe salt atmosphere for more than 2½ years! The ACCO *Aluminized* core (bottom) is almost completely free of corrosion. Compare this with the corrosion evident on the other two samples (Class A galvanized, at the top, and Class C galvanized, in the center). None of the specimens has been cleaned, nor the photograph retouched.

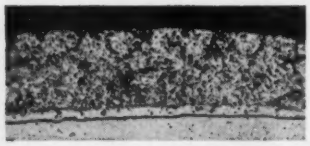


Field experiences prove advantages of

ACCO *Aluminized* WIRE

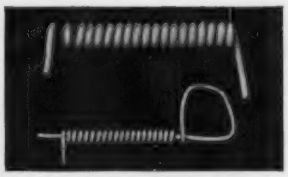
Since the development of ACCO *Aluminized* wire by PAGE, many laboratory and field tests have demonstrated its superiority over conventional galvanized for guy and messenger strand and overhead ground strand as well as for core wire in ACSR. Now, more than 20,000,000 pounds of ACCO *Aluminized* wire are in use—giving extended service life to its owners.

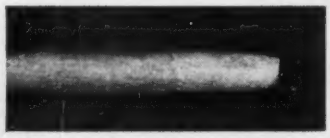
ACCO *Aluminized* wire gives vastly superior corrosion-resistance, yet retains all the other physical properties—strength, toughness, ductility, fatigue-resistance—of galvanized wire. Thus, no new problems have been introduced. The engineering investment has been fully protected and justified. This is why ACCO *Aluminized* wire is now specified by scores of electric utility companies which recognize its long-range economies.



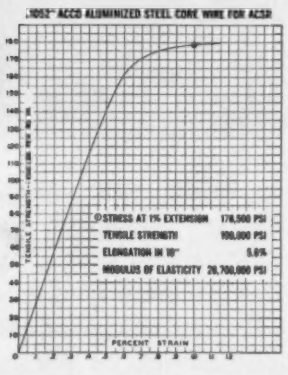
500X magnification shows how fine-grain aluminum is bonded to inner steel wire by a thin aluminum-alloy layer. Patented hot-dip process assures optimum bonding of the aluminum coating to the steel wire.

The aluminum coating on ACCO *Aluminized* wire withstands a multiplicity of forming operations. Ductility and adherence are outstanding, and meet specified wrap tests without fracture of coating.





Note neck-down of metal at point of break—a measure of ductility.


.1052" ACCO ALUMINIZED STEEL CORE WIRE FOR ACSR
STRESS AT 1% EXTENSION 176,500 PSI
TENSILE STRENGTH 198,000 PSI
ELONGATION IN 10" 5.0%
MODULUS OF ELASTICITY 28,700,000 PSI
PERCENT STRAIN

Typical stress strain curve—this one on .1052" Type SW core wire for ACSR—shows strength combined with excellent elongation characteristics. ACCO *Aluminized* core wire meets all of the requirements of ASTM Spec. B-341-59T.

PAGE

GET THE FULL STORY!

Write us at Monessen, Pa., for Booklet DH-537

ACCO

PAGE STEEL AND WIRE DIVISION • AMERICAN CHAIN & CABLE COMPANY, INC.

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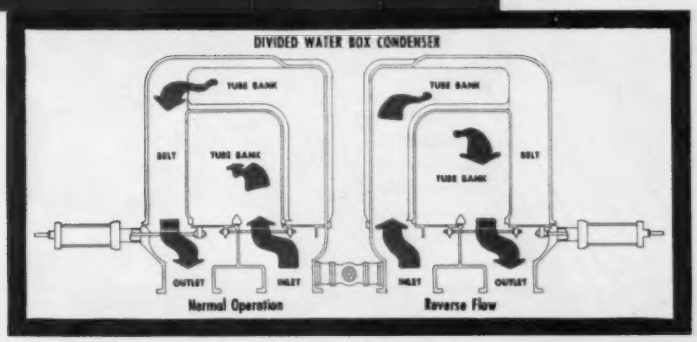
REVERSE FLOW "SELF-CLEANING"

ELIMINATES CONDENSER DOWN TIME

AND CUTS YOUR MAINTENANCE COSTS



C. H. Wheeler "Patented" Reverse Flow Condensers eliminate *manual labor* for cleaning. Refuse, twigs, leaves, debris, algae, or mussels are freed and washed away by back-flushing tubes and tube sheets, without shutting down the condenser.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure drop; hence high vacuum is maintained. Sluice gates for each half of the condenser move on a common stem. They are an integral part of the condenser and no extra external piping is required.

Each half of the condenser can be back-flushed independently or both halves can be flushed simultaneously, with either one or two circulating pumps operating.

For complete Reverse Flow "Self-Cleaning" story— write for catalog W-503. To know how Reverse Flow "Self-Cleaning" can cut YOUR condenser down time costs—call your C. H. Wheeler representative.

Affiliated sources for steam condensers, heat exchangers, pumps, nuclear steam generators and related components, sea water distillation plants, marine auxiliary equipment.

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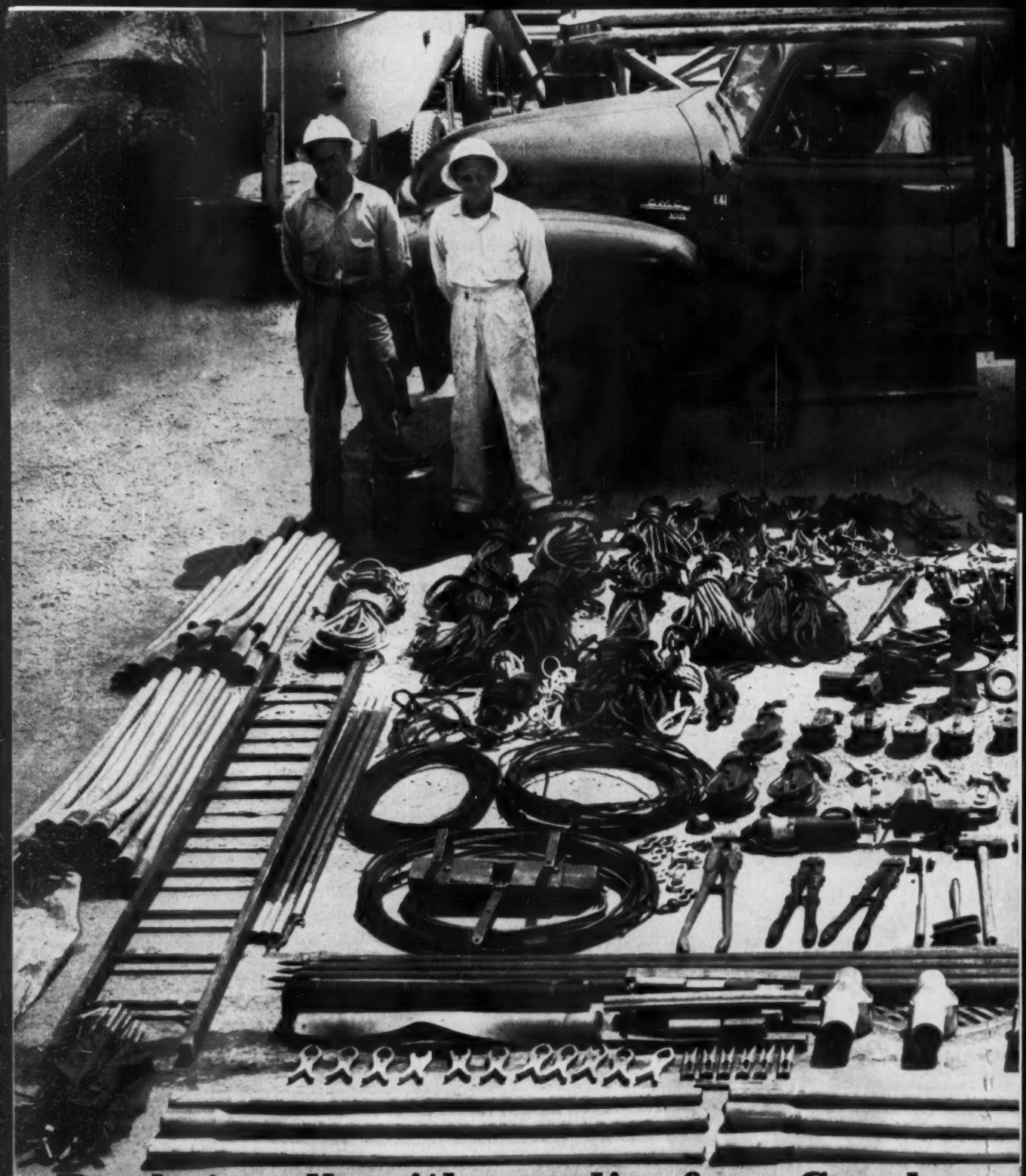

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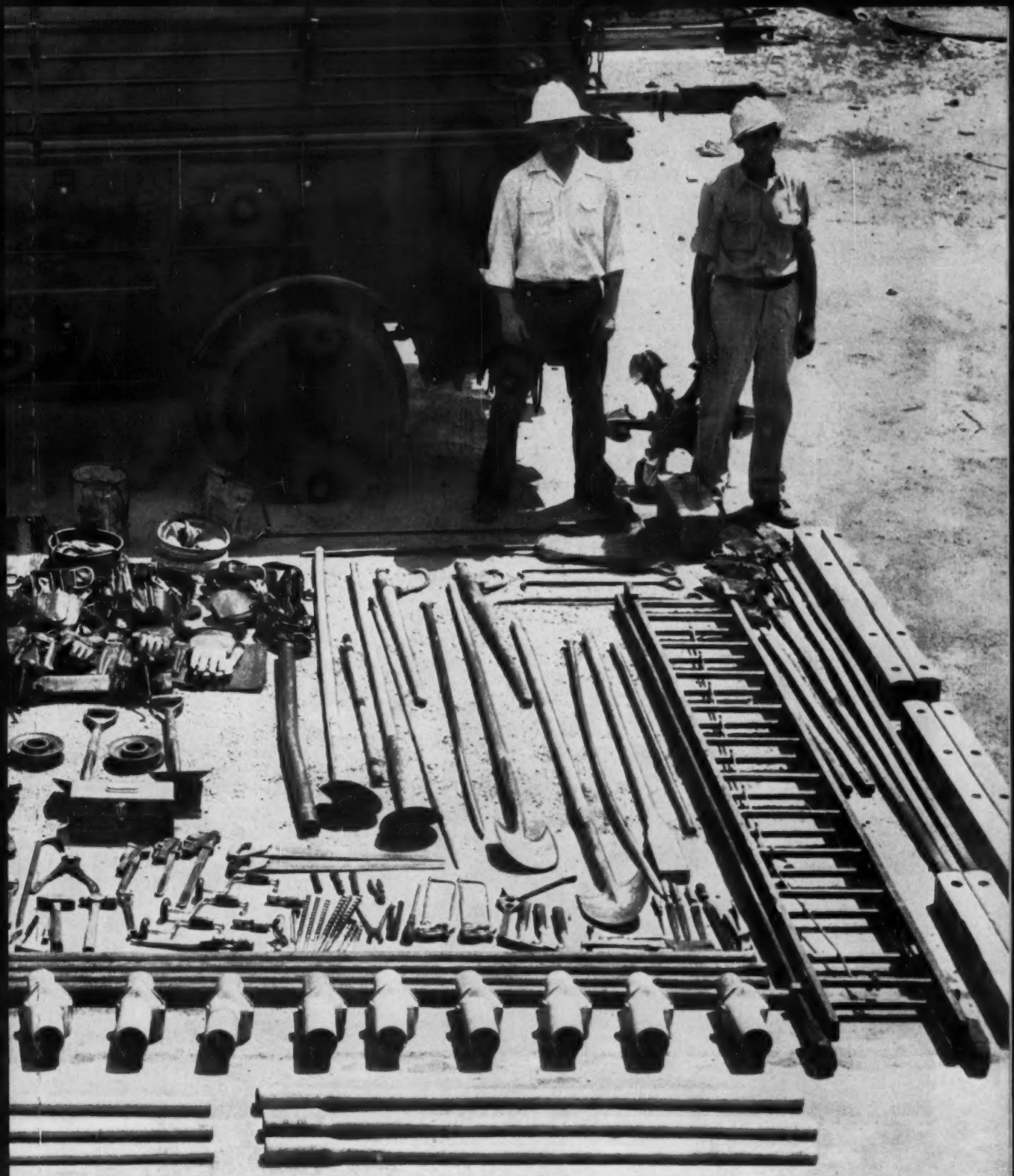
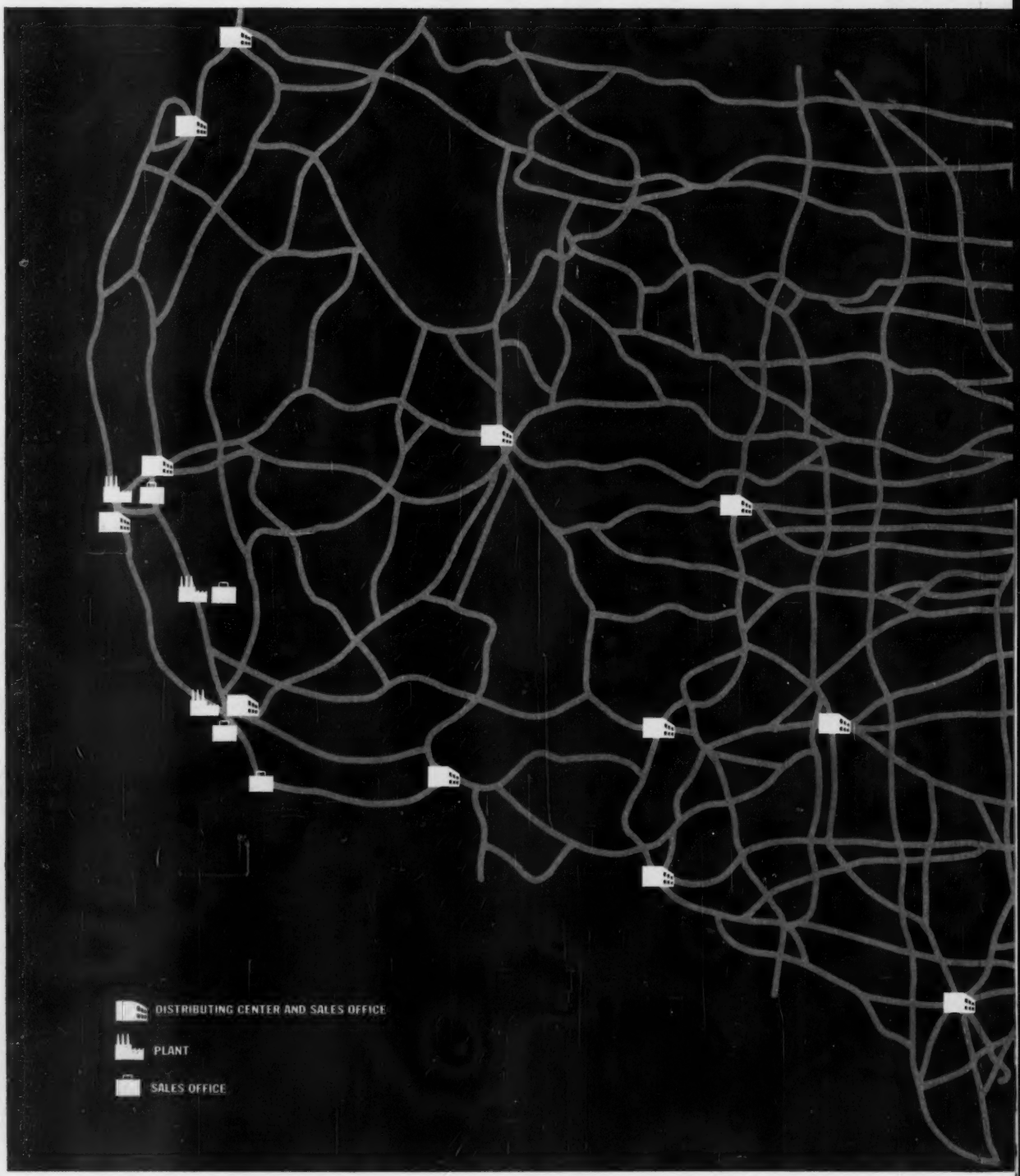
Keep your fleet ready for any service call, with all the supplies it needs—from hardware to wire and conduit. But don't tie up capital in do-it-yourself warehousing! Let your Graybar service center be your warehouse for service fleet supplies, as well as everything else electrical. ■ Prompt? We process your order the day we get it. And with your help—we can often deliver on the same day, too. Here's how: we work



out with you a planned purchase program, in which we stock what you need at our expense—even if your requirements are unusual. Your own inventory is minimum, yet you get what you want when and where you need it. ■ So don't pay the cost of possession that's the penalty of an unbalanced inventory. See Graybar—for everything. Graybar Electric Co., Inc.: local service to utilities through coast-to-coast warehousing.

GraybaR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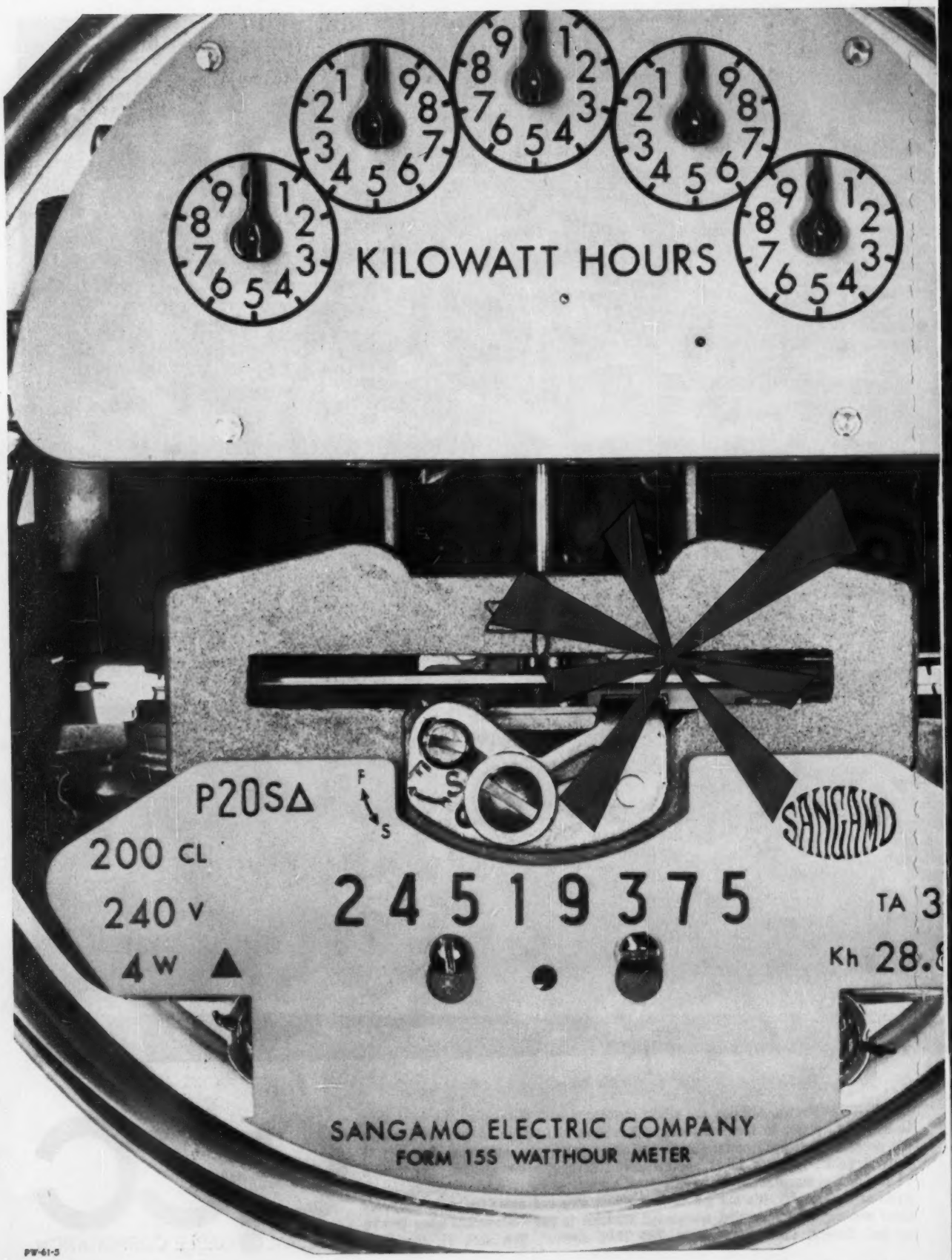
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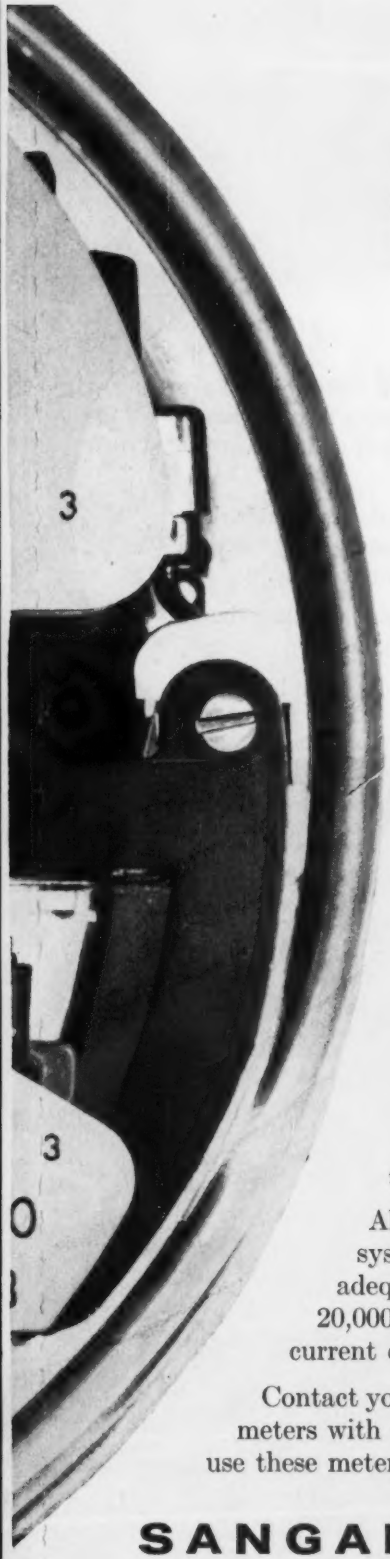
FORM 15S WATTHOUR METER

PW-61-5



the maker's Sangamo...
the meter's polyphase...
and the disk floats...

to provide the highly sustained accuracy needed to better measure today's large loads. The moving system of these 2 and 3 stator polyphase meters floats freely and permanently on a magnetic field created by opposing magnets. It's not supported or suspended by friction-causing components. *This is true magnetic flotation,* made extremely stable by specially bonded Alnico magnets that are dimensionally and magnetically uniform. It's available now on the complete line of Sangamo P20 (two stator) and P30 (three stator) polyphase meters.

P20 and P30 meters, with true magnetic flotation, retain all the advantages traditionally associated with Sangamo polyphase meters such as slow speed, high torque, high insulation level, low losses, and low starting watts. Construction is still sectionalized and parts are interchangeable . . . only the frame has been changed to accommodate the floating system.

The compact outline of Sangamo polyphase meters hasn't been changed. The P30, for example, is the *lightest, smallest, three-stator meter made . . . the only one with single disk, round cover design.*

All components of the P20 and P30 meters, including Alnico floating system magnets, damping magnets and electromagnets, have more than adequate surge resistance. The meters easily pass high current tests of 20,000 amperes through the neutral wire and 2,000 amperes through the current coil.

Contact your Sangamo Representative and get the full story on these exceptional meters with the moving system that is guaranteed for the life of the meter. Then use these meters to insure full revenue from large loads.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

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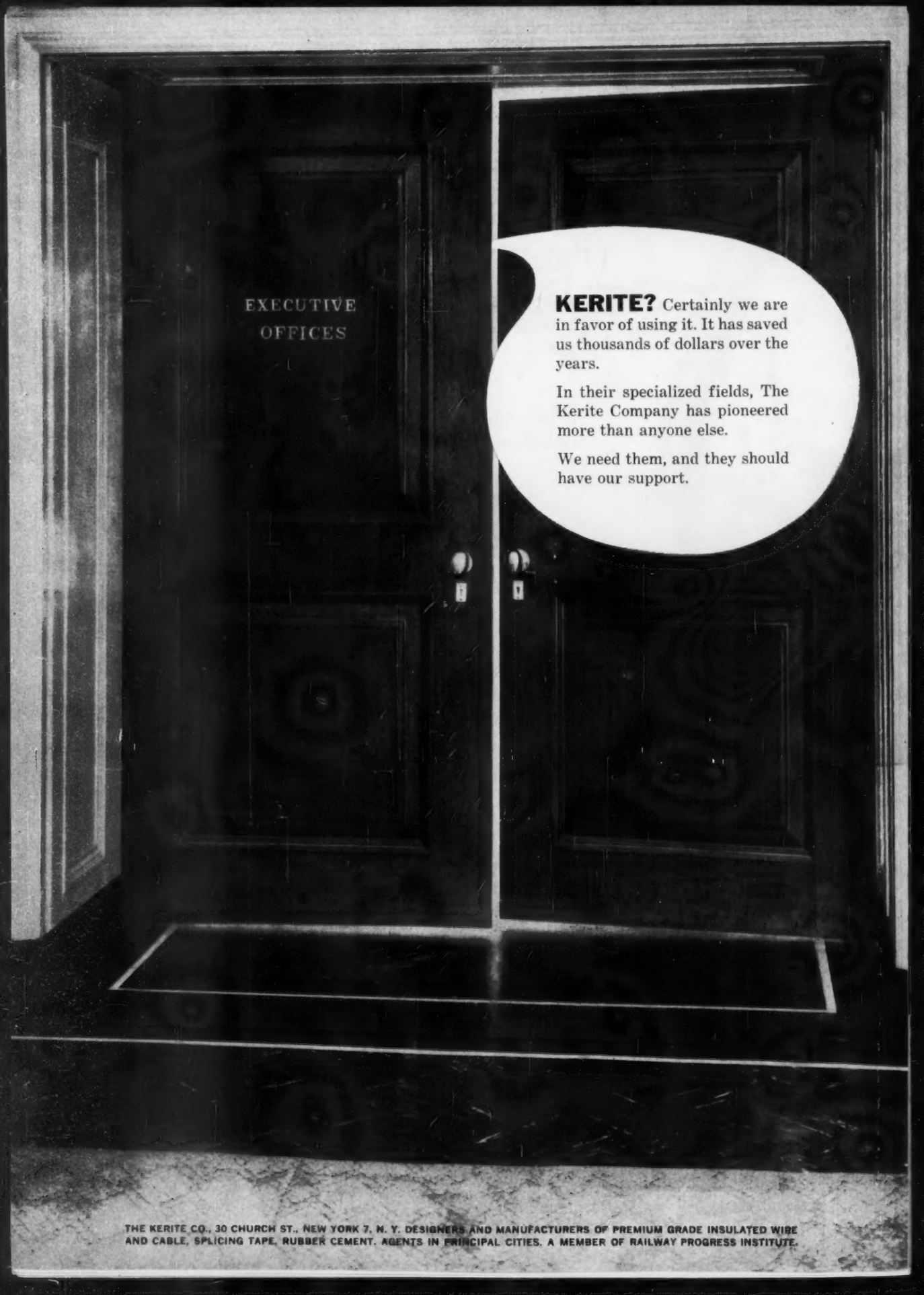
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KERITE? Certainly we are in favor of using it. It has saved us thousands of dollars over the years.
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NEAR Program Puts Utilities On the Spot

The entire electrical utility industry today finds itself in a suddenly critical position as a result of the federal government's apparently stepped-up drive to push the National Emergency Alarm Repeater (NEAR) system into every home, factory and commercial establishment.

Grave and complex questions of precedent, legality, cost responsibility, regulation, public opinion, etc., are being raised. Unfortunately such questions, legitimate and serious as they are, are being interpreted to mean the industry is reluctant to proceed cooperatively and affirmatively with the government in this endeavour, even though this is not the case.

The situation is rapidly becoming confused. This confusion appears to stem mainly from two problems which must be resolved before these complex details are attacked seriously, in depth, and, if necessary, on a utility by utility basis.

First, the federal government, through its executive branch and supported as necessary by the Congress, must plainly and specifically establish that the NEAR program is to be pursued as a matter of national policy. The speed with which this is done will be a measure of the program's urgency.

The urgency, once established, in turn will aid resolution of the second problem: The economic and technical feasibility of using the nation's existing power circuits for this specific job. It will determine how much time and money should be expended on additional tests and studies.

The electrical utilities already have offered to go far beyond their accustomed field of operation—power supply. They've accepted the premise that they have, in their transmission and distribution facilities, a direct link to virtually every home, factory and commercial building, and that their facilities seem ideal for use with the NEAR concept. Last month, EEI Pres Philip Fleger offered the collaboration of the investor-owned utilities with the federal government in pushing forward the program as then known. And non-investor utilities have responded as well.

One utility company has cooperated with Civil Defense for several years in tests of the NEAR system. But one series of tests on one utility system would normally be judged quite inadequate to guide a $1-billion nation-wide installation. Another company has agreed to install equipment for a state-wide test. Success in these larger-scale tests might be expected to spur rapid adoption of the NEAR system.

But now all electric utilities—governmental, co-operative, and investor-owned—are urged to plunge ahead with the NEAR installations and gamble $1 billion of their own funds on the successful functioning of a relatively un-tried system. They are asked also to supply, install and maintain the home receivers.

The electrical industry has been challenged to act in the national interest in an area beyond its normal function. It has been challenged in a manner which may well push it directly into the public spotlight where failure or delay could destroy the public's confidence in it as an effective arm of national defense.

Utilities appear to have no choice but to plunge ahead with their planning of NEAR installations, pushing the necessary engineering and the estimating of equipment with almost reckless abandon. At the same time their executives can press for clarification of the national policy and its legal and financial complications without risking the stigma of jeopardizing the national interest.

At all cost, they must make a conscious effort to insure that no outsider receive the impression that the non-technical problems are not possible of solution through full cooperation between government and industry.

FPC Examiner Rules on Appalachian Tax Case

Appalachian Power Co won part, lost most of its long-contested accounting case before Federal Power Commission Examiner Samuel Binder. Binder, who replaced Chief Examiner Edward Marsh in the case, made these findings, subject to a final ruling by the full Commission:

(1) Appalachian's reports to stockholders do not come under FPC jurisdiction, and therefore, cannot be required by the FPC to conform to the Commission's Uniform System of Accounts.

(2) Appalachian did violate, and is still violating, the FPC's uniform system—and specifically FPC order 204—by failing to adopt the Commission's deferred income tax categories instead of using a "flow through" basis.

(3) Appalachian did not suffer loss of due process of law through several controversial features of the FPC's handling of the case—substitution of hearing examiners, absence of Appalachian attorneys at a one-day hearing, or in a related opinion by the US Circuit Court of Appeals.

The case turns on two FPC orders: order 204, which amended the Uniform System of Accounts by adding specific provisions for the accounting of deferred taxes on income, and by prescribing specific income and balance sheet classifications for companies employing deferred accounting; and order 216, which was issued as a "clarification" of order 204, pointing out that the Commission didn't intend to give companies like Appalachian the option of reporting its accounts on a "flow through" basis.

Appalachian charged that order 216 was invalidly issued because it changed the substance of order 204—it made compulsory (deferred tax accounting) what order 204 had left optional (deferred or flow through). In other words, it was a new order, rather than a simple clarification of a previous order.

The case is a bellwether for 10 other utilities cited by the FPC in similar accounting complaints. Still farther-reaching could have been the FPC position on stockholder reports.

As to FPC control over stockholder reports, Binder said the FPC "has never proposed, noticed nor adopted any rule of regulation governing the content of stockholders' reports or requiring that financial statements be presented in any specific manner to stockholders, or requiring that . . . such a report be consistent . . ." with the Uniform System of Accounts. He added that all of Appalachian's common stock is owned by American Electric Power Co, that American Electric Power's financial statements "are not subject to regulation or control in any way by this Commission," and that "the Securities & Exchange Commission has itself acknowledged that it has little or no power to regulate the content of the stockholders' reports . . ." Appalachian follows different state rules on accounting for its stockholder reports.

Binder's ruling on stockholder reports was a complete rejection of the FPC staff counsel's position.

Binder, however, accepted the FPC staff position that Appalachian has violated since 1958 the Commission's Uniform System of Accounts, as amended by orders 204 and 216, and he ordered the company to file revised annual reports to the Commission within 30 days under the new categories. Almost $30 million is involved in these accounts.

Binder also denied company charges that any due process of law had been violated through substitution of hearing examiners. And he rejected the position that the company hadn't had an opportunity to present its direct case during public hearings (EW, Nov. 14, 1960, p 55) "Even if everything which is contained in Appalachian's response were stated from the witness stand during the hearing," he said, "it would not be a sufficient answer to the case presented by the staff . . ."

Appalachian's appeal of FPC order 216 to the US Circuit Court of Appeals, and the court's subsequent order, "does not of itself constitute a mandate to re-open the proceedings," Binder added, and "this is a matter which, under the court's order, should be considered by the Commission itself, since it involves the validity of an order which the Commission issued . . ." Binder also noted that Appalachian's violation of the FPC orders, 204 and 216, was not willful, therefore not subject to the fine and imprisonment clause of the act.

Holum Asks for FPC Delay on Marble Canyon

Assistant Interior Secretary Kenneth Holum formally raised the possibility of a federal Marble Canyon-Kanab Creek hydro-power project, on the Colorado River, Ariz., last week, as Federal Power Commission hearings resumed on a license application by the Arizona Power Authority to build it alone.

Holum, in a letter to FPC Chairman Joseph Swidler, asked Swidler to defer the Marble Canyon hearings and issue no license in the matter, until Congress has time to "consider federal resource development in the light of final disposition by the US Supreme Court" of the Arizona vs California water rights case.

Holum added that the Bureau of Reclamation had been unable to complete studies of the Colorado River, between Hoover and Glen Canyon Dams, because of this long-standing litigation, but the "public interest requires full opportunity" by the bureau to complete its investigations of the Marble Canyon project, possibly as part of the Central Arizona project.

Holum concluded that Interior couldn't release federal-owned lands along the Colorado River for an FPC hydro-power license until it completed these studies. His authority lies in a proviso in section 4 (e) of the Federal Power Act.

Meanwhile, the FPC hearings, now under Chief Hearing Examiner Edward Marsh, resumed after a several-month delay. Marsh hasn't acted on testimony by the Los Angeles Department of Water and Power or the Metropolitan Water District of Southern California that a Marble Canyon-Kanab Creek power development would be better suited for the Lower Colorado than Arizona Power Authority's single Marble Canyon project. Nor has he ruled on Arizona's motion to strike this testimony as irrelevant.

The Marble Canyon project, severed earlier from the competing "Arizona vs Los Angeles" Bridge Canyon applications, was thought to have smooth sailing, since Arizona was the only applicant. However, at hearings last summer, Los Angeles charged that Marble Canyon alone wasn't best suited for the river, and urged a delay in the case until more studies could be made.

Los Angeles said it had signed a contract with the Bureau of Reclamation last June to study the Marble Canyon-Kanab Creek development, and that a tentative report was reached Oct. 4. A more detailed report, costing a few million dollars and taking two years to complete, now is being urged by Los Angeles, to be shared in jointly by the city, the states of California, Nevada, Arizona, and the Bureau. Los Angeles wants the FPC to request the Bureau to make such a study, and also wants the FPC to freeze the Arizona application until then.

Arizona's Marble Canyon application calls for a 400-ft dam at Marble Canyon, with a capacity of 510 Mw and annual average energy output of 2.49-billion kwhr. Los Angeles' alternate plan calls for the Marble Canyon site mainly as a diversion dam, with a 44-mi, 36-ft concrete tunnel—up to a mile below the ground—to a power plant downstream at Kanab Creek. Here, a 470-ft dam could be built with a rated capacity of 2,030 Mw, peaking capacity of 2,300 Mw, annual average generation of 7.968-billion kwhr. Cost of this mammoth undertaking would be more than $1 billion, and might take 10 years to complete. Los Angeles thinks it has about a 1.15-1 benefit-cost ratio.

Much of Los Angeles' testimony is only tentative, and for this very reason, the city feels it, Congress and the Bureau should have more time to study the plan.

Arizona, of course, feels this is outside the proper FPC procedure in considering Marble Canyon.

The Kanab Creek plant would be near the tailwater from the still-to-be-decided Bridge Canyon project. Bridge Canyon was severed from the Marble Canyon project so that Arizona and Los Angeles could get together, possibly, on a joint project. The Bureau of Reclamation also is interested in the Bridge Canyon site. Transmission lines from Kanab Creek and Bridge Canyon would tie in, if built by the Bureau, to the Hoover-Parker-Davis system and into the Colorado Storage Project—Glen Canyon, Flaming Gorge and Curecanti projects. Los Angeles, also, suggested that federal lines might be built westward toward Los Angeles, tying in with the California-BPA intertie.

Delaware River Compact Signed by President, Four States

President Kennedy and representatives from the states of New York, New Jersey, Pennsylvania and Delaware have signed the Delaware River Compact (see photo).

Under the compact, a new commission has been established which will have jurisdiction over control and development of adequate water supplies, pollution control, flood protection, watershed management, recreation, hydroelectric power, and the regulation of withdrawals and the diversion of Delaware River water.

Interior Secretary Stewart Udall has been designated by President Kennedy to be the federal representative on the commission, which will hold its first meeting in Trenton early in December.

The compact provides machinery for a federal-state partnership to plan and carry out development projects. Congressional approval will be required for all projects involving federal expenditures. For power projects, the compact does not spell out public preference rights (EW, Sept. 25, p 14).

WITH THE DELAWARE RIVER COMPACT SIGNED, President Kennedy poses for pictures with (seated left to right): Gov Robert Meyner of New Jersey, Gov Elbert Carvel of Delaware, and Gov David Lawrence of Pennsylvania. New York's Gov Nelson Rockefeller was unable to attend but sent a representative

SPORN

COOK

KAMMER

AEP Elects Donald Cook President

Donald C. Cook was elected by the board of directors last week to succeed Philip Sporn as president of the American Electric Power Co. Cook, vice president and a director, assumes office Dec. 1, the date of Sporn's retirement. He succeeds Sporn as president of American Electric Power Service Corp also.

Cook, fifth president in AEP's 55-year history, is a former chairman of the Securities & Exchange Commission. Joining AEP Service Corp in 1953 as vice president and assistant to the president, he became executive vice president for legal, finance, and accounting in 1954.

Elected a parent company director in 1960, he has been a vice president and director of each of the AEP system's six operating utility companies. He is a native of Escanaba, Mich, and holds law degrees from George Washington University. He is a certified public accountant.

The parent company board also established a new standing AEP System Development Committee, with Sporn as chairman, and he will continue as a director, executive committee member, and advisor and consultant to the directors and officers of AEP.

H. A. Kammer, executive vice president-engineering and construction, was elected by the Service Corp directors senior vice president, also effective December 1.

Sporn, associated with AEP since 1920, has been president of the parent company and all its subsidiaries since 1947. Since 1933, when he became chief engineer, Sporn has led the AEP system's extensive technological pioneering in electrical generation, transmission, and distribution, as well as in the total-electric concept promotion. He is former president of Nuclear Power Group Inc, and remains chairman of the East Central Nuclear Group's research and development committee. He was instrumental in the formation of Ohio Valley Electric Corp and was a consultant and advisor to educational institutions and to private and governmental agencies here and abroad.

OCD Backs Off on Wiring NEAR Devices

The federal government is backing away from insisting that National Emergency Alarm Repeater (NEAR) devices be wired into every home by local electric utilities. However, the government will ask each utility to buy the alarm devices at prices ranging from $7-15 each, sample test them like watthour meters, and distribute them (one per home) to be plugged in.

This change in government thinking was brought out by Paul Vischer, director of shelter and communications for the Defense Department's Office of Civil Defense, at an informal gathering of California state officials and utility representatives last Tuesday in San Francisco to discuss NEAR.

As the home devices will constitute 90% of the cost of NEAR, Vischer said, the utilities may as well pay the other 10% for signal generating equipment. And he left it up to the individual utilities and public utility commissions to determine how to cover costs—"After all, the people must pay for it, however it is done."

Vischer said the OCD is looking for five pilot states to install the first NEAR equipment to come off the production lines.

Meanwhile, there were initial industry group reactions to the disclosure last week that the government would ask the utilities to finance the NEAR equipment and recover expenses from their customers (EW, Nov. 6, p 56). Representatives of public, cooperative, and investor utilities have expressed their willingness to cooperate with OCD, but all have raised questions as to the financing, ownership, and responsibility proposals set forth by the Pentagon (see editorial, p 45).

At the Pentagon, there was still no word that a decision had been made on technical standards for the NEAR receivers. However, there was no indication the early December kickoff date would be delayed.

Alcoa Sale May Test TVA Expansion

A public-private power fight in North Carolina has started litigation that may set a national precedent for future court action on Tennessee Valley Authority expansion. But officials of TVA say the agency will stand on the sidelines in the dispute.

The fight involves the distribution facilities of Nantahala Power Co, a wholly-owned subsidiary of Aluminum Co of America. Alcoa set up Nantahala Power in 1929, primarily to serve the company's Alcoa, Tenn., plant.

Within the past couple of years, Alcoa has decided that it needs all of the power generated by its western North Carolina hydro facilities and wants to sell the distribution facilities.

As a result, Duke Power Co has contracted to pay $4 million for the six-county, 14,000-customer distribution system.

But several groups of citizens of those six counties, realizing that their rates will go up by an unspecified amount after Duke takes over, are trying to get power from TVA through the Blue Ridge Electrical Assn, Inc, at Young Harris, Ga. (just across the state line), or from the Haywood Electric Membership Co, at Waynesville, N. C. These two co-ops want to buy Nantahala.

The North Carolina State Utilities Commission, which must approve the Duke-Nantahala deal, has begun hearings on the subject. The hearings' avowed purpose will be to decide whether to allow the Nantahala-Duke transfer, or whether the area will be served by one or more co-op group. The commission has also agreed to let the two co-ops appear as interested parties at a hearing set for December 12.

Duke Power has said it would fight bitterly "any extension of TVA power" into western North Carolina. Duke and Nantahala will of course stand on the 1960 law limiting TVA to territory it served in 1957. Duke also pointed out that Haywood, one of the petitioning co-ops, had a right to intervene in the case as a customer of Nantahala. But the company unsuccessfully denied the right of Blue Ridge to intervene as it buys power from TVA and has its offices in Georgia, although it serves two North Carolina counties.

Opposition to Duke's takeover of the facilities comes from at least a half-dozen splinter groups in the six-county area. So far, no dominant leader, or leadership group, has emerged as the public-power spokesman in the fight. However, whoever does speak for the Nantahala customers is expected to claim that TVA can legally serve the Nantahala customers because the area has been getting TVA electricity for many years.

Nantahala claims it has never purchased power from TVA; it has, instead, made its generation available to TVA at the point of generation, taking back from TVA what is needed for the utility load and for the Alcoa, Tenn., plant.

TVA says it is "willing to serve the people of the area." The agency, however, says it will not get involved in the fight.

Counsel for the co-ops want the commission to hold up approval of the Duke purchase until they have had time to develop an alternate plan. The co-ops say they know the commission could not force Nantahala to sell its facilities to them, but they think Nantahala would be willing to negotiate if the deal with Duke were turned down.

Nantahala says it is firmly committed to its contract to sell to Duke and will not listen to any other offers as long as the contract is in force.

REA Grants "New Criteria" Loan

The Rural Electrification Administration has put its new policy of protecting existing REA systems into practice with a $20,350,000 loan to Alabama Electric Cooperative Inc., Andalusia, Ala.

Previously, REA made loans only when a cost savings was possible, or when power wasn't otherwise available. The new security criteria for making loans are applied where REA feels the security or continued operation of an REA system is endangered.

The 2% 35-year loan to Alabama Electric Co-op will fully finance a $12-million 66-Mw steam electric plant near Jackson, Ala., and transmission lines estimated at $8,350,000.

A portion of the line—227 miles at 115-kv—will cross Alabama, and tie in the Jackson plant with the Southeastern Power Administration's Walter F. George Dam in eastern Alabama. Half the output from the dam—or about 41-Mw—will go to the Alabama co-op.

Another section of line—422 miles at 46 kv—will extend into Alabama Electric co-op's service area, supplying seven distribution co-ops in southern Alabama and two in northern Florida.

The Alabama distributors serve 56,000 rural consumers in 14 counties, and the Florida co-ops serve 9,550 consumers in four counties.

Of the nine distributors in Florida and Alabama, seven are now served wholly or in part by private power—chiefly the Alabama Power Co and Gulf Power Co.

Georgia Power Seeks Flint River Study Permit

Georgia Power Co last week asked the Federal Power Commission for a three-year preliminary permit to study several possible hydro-power projects within a 40-mile stretch of the Flint River in Crawford, Taylor, Upshur, Pike, Talbot and Meriwether counties, Ga.

The company is considering three sites on the Flint, with a total gross head of 380 ft, generating capacity of 300 Mw, average annual output of 350-million kwhr. The sites (and approximate gross heads) are: Lower Auchumkee Creek (90 ft), Liza Creek (130 ft), Spewrell Bluff (160 ft).

The company didn't estimate the cost of the proposed development. The FPC hasn't yet acted on the application.

Advanced Reactor Types Discussed

IAEA-sponsored meeting in Vienna looks into radically new nuclear reactor concepts as well as improvements in existing designs

Vienna (McGraw-Hill World News)—A glimpse into the future of advanced power reactors was given a group of 200 experts from 13 countries last month under the patronage of International Atomic Energy Agency.

Expressed purpose of the meeting was to review the numerous approaches to new reactor types, fuels, coolants and moderators on the basis of concept, rather than dealing either with engineering or economics. Most designs discussed still are drawing-board wonders. Highlights of the meeting included the swapping of ideas on nuclear superheat for power and high-temperature types. Minor sensation: the Netherlands' continued research on homogenous reactors, a field given up by most other countries.

Nuclear Superheat

United States approach to nuclear superheat by either integrated cycle or hook-on scheme is complemented by Russia's approach of using a pressure-tube boiling-water graphite-moderated reactor with superheater inside the reactor core. The first Soviet nuclear power station used this basic system, which is now being modified for the 100-tMw station nearing completion at Byeloyarsk. US systems cited as examples are Borax 5 for integral superheat and the Vallecitos station for the hook-in scheme.

Sweden argues use of D_2O in superheating plants replacing ordinary water, admits a slightly raised fuel cost but claims a reduction in over-all investment cost. Another Soviet concept, foreseeing a two-circuit scheme, figures on pressures between 3,410 and 3,560 psi at 1,020F-1,110F in the first loop and 3,560-4,270 psi at lowered temperature (930F-1,020F) in the secondary loop. Efficiency between 40 and 45% is claimed.

High-Temperature Schemes

"Gas-cooled reactor designs of high temperature are a serious contender in the race to provide economic nuclear power," according to US's Dr R. Shanstrom, speaking of the EBOR project, the helium-cooled and beryllium-oxide-moderated unit coupled to a closed-cycle gas turbine.

British work done mainly on the Dragon project consists of testing the unit during operation and conducting post-operational material studies. The UK's G. E. Lockett thought of the unit as having "very good development potential" owing to high output per core volume, high gas outlet temperature and high utilization factor from fuel.

Pebble-bed designs under study in the US progressed far enough to think now of continuing investigation in a 5-10-tMw experimental station. Yugoslavia's Zeric proposed the concept of uniformly, rather than randomly, packing pebbles.

Japanese scientists are interested in semi-homogenous reactor types, working in one study on a scheme close to Dragon, another study concerned with replacing gas, helium, for example, with molten bismuth.

Fast Breeders

First indication of details on France's Rhapsodie station, given by C. P. Zalewski, indicated that this 10-tMw-plus unit now under construction in southern France will be sodium-cooled with fuel of mixed plutonium and U-235. Criticality is set for mid-1964.

United Kingdom research at Dounray is well under way. J. L. Phillips told his audience that the main purpose of current work is to gain experience with active sodium circuits and to perform irradiation tests on experimental fast reactor fuels.

A Russian spokesman surprised symposium delegates by saying that a 5% burnup was achieved at plutonium-oxide-fueled BR-5 as against 2% calculated. Three years of experience with still-operating BR-5 appear to confirm, according to Prof Bonderenko, the possibility of building this type reactor on an industrial scale.

An interesting merchant-vessel reactor of 20,000 shaft hp, described by Dr P. E. Malague of Belgium, controls output through variation of the moderator. Moderation here is provided alternately by D_2O and ordinary water. Rods are used for emergency shut-down only. A three-year fuel cycle is foreseen for this Vulcaine reactor, which is said to cost less than pressurized types.

Dr A. Bloch, US, speaking out for molten salt reactors, warned that high yield is to be balanced against disadvantages of extreme radioactivity and need to keep salt above its 840F melting point. In Czechoslovakia, work is being done on a power reactor design in which fuel is in an aqueous suspension of uranium oxide.

The meeting aimed at looking into work on improvement of proved reactor designs and, more importantly, took a look at radically new concepts for new types. The ratio of 5 to 26 papers on first and second of the meeting's unwritten aims showed the degrees of interest.

Delegates to the meeting agreed on the value of studying scientifically advanced but untested reactor designs, but none among them thought of comparing merits.

Poland Faces Capacity Shortage

Vienna (McGraw-Hill World News)—The Polish government views the coming winter with fear. This year's 692-Mw power expansion program has been less than half fulfilled in the first nine months. Some 352 Mw of planned capacity is either unfinished or delayed.

Warsaw is expected to have a demand exceeding supply by as much as 100 Mw. A 400-Mw capacity gap for the whole country is foreseen.

Main reasons for the gap are delays in the import of turbines and other station gear.

PRIMARY COMPARTMENT, left, has primary bushings, standoff insulators, jumper cables and four potheads

12-Kv Pad Mounts Standardized

Transformer and terminal cabinet designs prescribed by Western Underground Committee

The Western Underground Committee, composed of representatives of some 20 investor-owned and municipal utilities in California, Arizona, Nevada, and Hawaii, has adopted a standard design for 12-kv pad-mount transformers. The standard specifies:

1. That the unit's protection shall embrace secondary breakers and two primary fuse links for single-phase operation on a 3-phase, 3-wire, 15-kv-class system. High-voltage taps shall not be included unless specified by the operator. The low-voltage rating shall be 120/240 v, and standard sizes, 25, 37½, 50, 75, and 100 kva.

2. The primary and secondary compartments shall have separate doors in a divided cabinet. The primary compartment shall contain two high-voltage bushings attached to the transformer and two high-voltage stand-off insulators attached to the top of the cabinet for sectionalizing the cable. Provision shall be made for four potheads or stress-cone terminations. The secondary compartment shall contain three bushings, including an insulated neutral, and the circuit-breaker handle, all attached to the transformer section.

3. Transformers and cabinets shall be interchangeable among those of different manufacturers, and the transformer, bolted to the cabinet, may be installed later than the cabinet or replaced without disturbing it. A false cover shall be provided for the back of a cabinet installed without the transformer.

4. The primary shall be at 12 kv, the single-phase line consisting of two insulated phase conductors.

Most Systems 3-Wire, 12 Kv

Most California systems are 3-wire, 12 kv. As the transformer is normally connected as part of a single-phase loop between two risers, four sectionalizing points and four terminations are needed in each 12-kv cabinet. A 7.2-kv cabinet needs only two of each. An important decision made by the standard-makers was not to require sectionalizing switches, whose inclusion would have raised the cost and dimensions and made grounding provisions and safety requirements difficult.

Moving jumper cables when the circuit, amounting to half the primary loop, is de-energized was proposed as the best method of sectionalizing. This can be done by a lineman abiding with existing safety rules, according to Jack Lawson, Pacific Gas & Electric Co.

Probably the most troublesome specification for a manufacturer is the way of joining cabinet to transformer. This must be precise to assure the interchangeability feature. So far, only one manufacturer has supplied pad-mount units meeting the new specifications, although others are expected to follow soon.

Some manufacturers, while blessing the standard's objectives, have stated their own preferences for a functional, less rigid standard consonant with changing customer requirements and product development. Bolt-down dimensions, they aver, would permit the desired interchangeability of complete units for at least the period preceding adoption of industry-wide standards.

But C. B. Anderson, WUC chairman, said that the new standard provides a starting point and a direction, and that adoption of the standard is urgent in order to obviate multiplication of designs on a system.

WUC has labeled its standard "Style 1," this open-minded designation allowing member companies to order units on any basis it pleases. But five member companies have placed orders based on it.

Say Investment Puts Premium

PEA prime movers meeting speakers describe financing, selection of new plant and retirement of old property

An electric utility company's huge investment puts a premium on planning for expansion and financing, the Pennsylvania Electric Association, Prime Movers Committee, was told recently at West Point, N. Y.

A utility's investment is three to 35 times that of other industries, declared Allan G. Mitchell, Philadelphia Electric Co, citing 1950-60 figures from seven Pennsylvania utilities to illustrate his statements. The companies, besides that of which he is comptroller, were: Pennsylvania Power & Light, Metropolitan Edison, Pennsylvania Electric, West Penn Power, Duquesne Light, and Pennsylvania Power.

Regulation, federal and state, Mitchell continued, restrains a utility's activities, introducing inflexibility, as all forward plans must be checked and made to fit into the regulatory framework.

"Plant investment for a typical utility," he noted, "now (1960) averages about $4.72 for each dollar of annual revenue and $137,000 per employee. Even steel has a plant investment of only $1.73 per annual sales dollar and $28,000 per employee.

"Because of regulation and other economic differences, utilities must operate within a narrower band than industries that take advantage of boom years to offset poor ones. And from the nature of its service, stable rather than fluctuating rates are desirable."

Mitchell explained that industrials could take advantage of large consumer demand for goods during the post-war inflation and thus improve their earnings by increasing prices. But the utilities, he said, had no such free hand. He noted that utilities' earnings from common stock averaged 10 to 12%, in contrast with successful industrials' 15 to 20% a year.

Requirements Large

"Hence, a utility's large capital requirements, coupled with its narrower margin of earnings," he declared, "calls for a different financing program. Its capital requirements are so large that, even were no dividends paid, but the earnings plowed back into plant investments, a utility would still have to raise additional capital by selling securities on the open market."

Mitchell noted that, although revenues increased 65% and electric sales about 50% in the decade, utility plant investment doubled. Such doubling was due to rapid growth in plant, including rebuilding of normal reserve capacities, rising cost levels, and changing load characteristics. This trend, he warned, points up the need for keeping plant investment in line with revenue and sales.

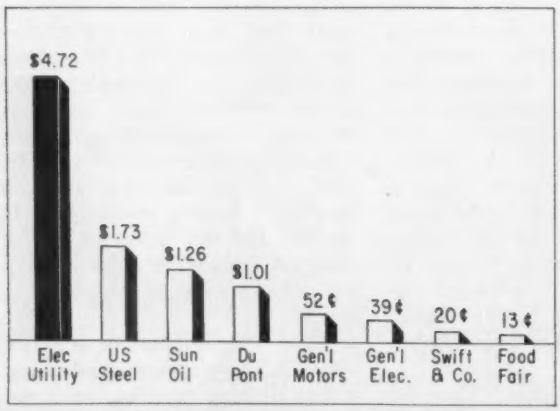
In the seven Pennsylvania utilities, the ratios of operating and maintenance expense—items most readily controlled by management—declined markedly from 1950 to 1955, and there has been a slight downtrend since, he said, adding:

"But the change in taxes and the steady uptrend in the depreciation provision, as plant grew, offset this gain almost entirely. As a consequence, the total operating expense ratio showed only a slight improvement, 75.8% of revenue in 1960 vs 77.3% in 1950."

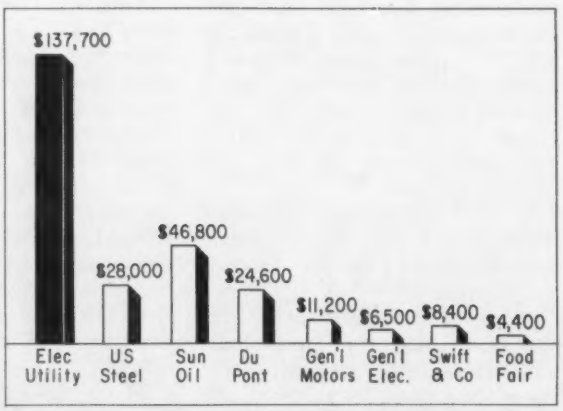
Specifying fuel and labor as the errant items, Mitchell said: "If fuel economy can be assured by plant design and operating practices and effective use of manpower by sound organization, supervision, and responsibility accounting, the battle for effective cost control will be won."

He cited a steady improvement in heat rate as highlighting the experience of one of the seven companies and went on to explain:

"Addition of new plants and continuing improvements in existing stations have produced a downtrend in fuel expense per kwhr, even with a slight rise in the cost of fuel per million Btu. Effective utilization of manpower has helped to hold labor

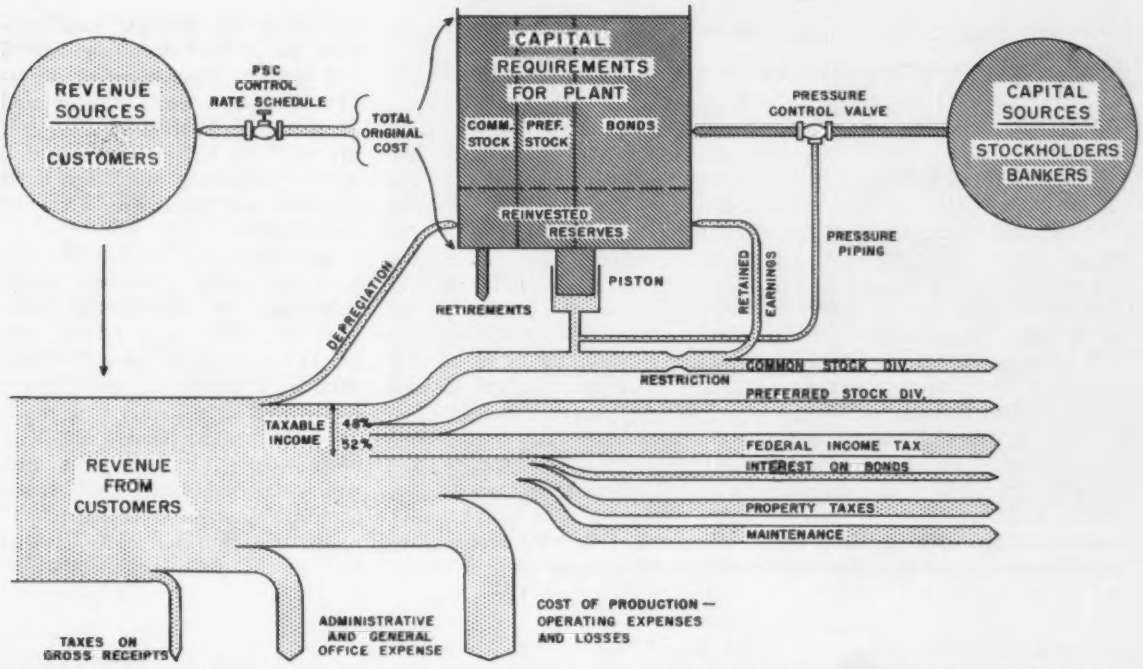


ELECTRIC UTILITY INVESTMENT (1960) in plant exceeds by far that of other industries per dollar of revenue



INVESTMENT per employee is also higher by far than that for steel, oil, automotive, other industrial companies

on Utility Planning, Financing



WATER FLOW ANALOGY used by J. L. Davidson who developed it to illustrate for engineers how capital funds and revenues are siphoned from a utility through operating expenses, maintenance, depreciation, taxes, etc.

expense almost level, even when wage rates more than doubled. The 'Other Expense' category maintains a fairly steady relationship, close to 9% of revenue and about 50% of labor expense."

While many aspects of the utility business are quite stable and inflexible, Mitchell said, there is nothing stable about the cost of money and the rates utilities must pay to keep new capital flowing their way. Since they must expand to meet consumer demands, they have little choice in the timing of their financing. The best they can do is lay financing plans on a sound, long-range basis and do what they can to take advantage of favorable market conditions.

"In the last year or so, the dividend yield rate on common stocks has been lower than on bonds, which makes the present a relatively good time for selling additional common stock," he stated. "While utility stocks have lagged behind industrials, they have had a much more favorable record than some, such as railroad stocks."

Plant addition affecting a utility company's earnings affects also the flow of capital, said James L. Davidson, Long Island Lighting Co. Applying this axiom to the choice among several plans, he said:

"Suppose we adopt a plan which might be an engineer's dream of an installation 'bigger and better' than the last one, but having added features that are not necessary. The additional capital to pay for the extras brings extra charges—in taxes, depreciation, operation, and maintenance. Yet revenue and other expenses are not changed by these features.

Raising Capital Affected

"In such a case, earnings are actually reduced, affecting the ability of the company to raise capital not only for the extra features, but for the essentials as well," he continued.

"If engineers persist in the nice but unnecessary additions," he continued, "the company may be permitted to obtain from the customers the extra revenue for an adequate return. Although the extras provide increased service reliability, or other customer benefits, the effect of their inclusion is felt first by the stockholders, and the customers end up paying for them.

"Engineers are, therefore, in the position of playing 'papa knows best' with respect to customers' service reliability and rates. In this role, they are responsible for determining what is best not only for his service, but also for his pocketbook."

Differences among alternative plans expressed in dollars enable engineers to exercise judgment, Davidson went on. The prime consideration is whether the plans produce the same performance, or the same service reliability. An engineering study doesn't concern itself with absolute profitability, but with the utility's responsibility to serve an increased load. The engineer assumes that the utility will be permitted to earn an adequate return over the life of the installation—that the necessary revenue for all annual costs and expenses will be forthcoming from the customers.

"This leaves the engineer free,"

(*Continued on page* 95)

New 342-Mw Unit to Be Controlled

Sewaren Station Unit 5 of Public Service E&G, slated to go on line next summer, will be operated by digital computer

R. A. BAKER, Chief Engineer, Electric Engineering Dept, Public Service Electric & Gas Co, Newark, N. J.

A completely automatic system will control the new 342-Mw unit which Public Service Electric & Gas Co will put on the line next summer at Sewaren Generating Station, N. J. The station's Unit 5 will be operated by a digital computer.

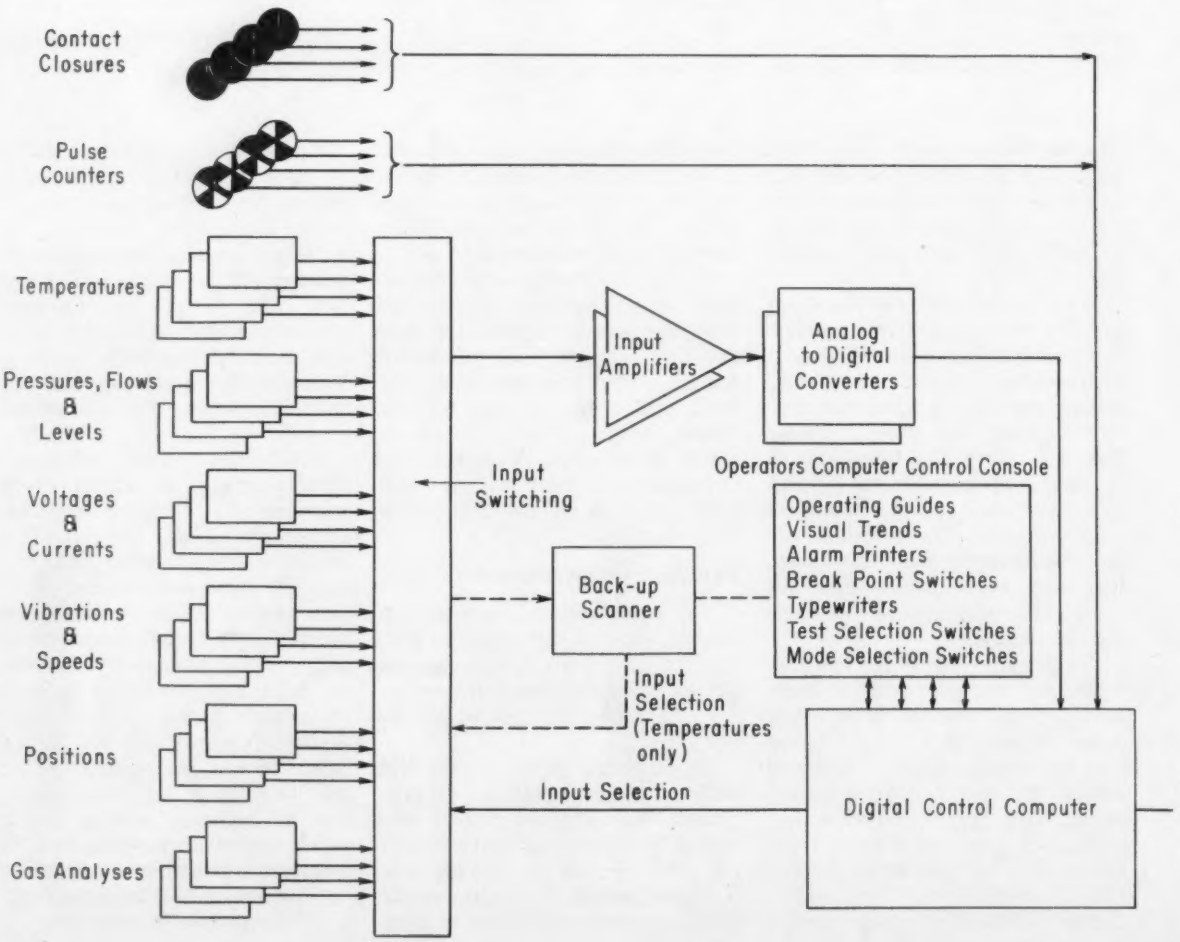
Such control was selected for the new unit on the basis of the company's recent engineering of a digital performance computer for the two units at Bergen Generating Station. Experience there demonstrated the feasibility and desirability of on-line computer control for Sewaren No. 5.

Total installed cost of the control system has been estimated at $850,000, including overhead and contingencies. As the computer will eliminate some control and logging equipment, total expenditure over and above that for a conventional plant will be about $755,000. This amounts to only slightly more than 1% of a total estimated cost of $66,500,000 for Sewaren Unit 5.

Advances in station control technology over the past decade have produced self-contained analog systems which have proved effective and reliable. The burden of coordinating such separate systems, in the light of all the pertinent data, however, has severely tested the mental and physical capabilities of operators. Fatigue, lapse of memory, and deteriorating reaction time suggest the need for an automatic control system, especially for the more complex and expensive new and larger units.

The turbine of the 342-Mw unit is of the double 3,600-rpm, cross-compound type with throttle conditions of 2,400 psig, 1,100F and reheat to 1,050F. Steam will be supplied by a subcritical, once-through boiler fired with Bunker C or residual fuel oil. The relative simplicity of measuring oil input, compared with measuring coal input, made complete automation attractive.

The new unit will be in a plant next to the existing four units at



Automatically

Sewaren, yet entirely separate from them except for sharing the same sources of backup auxiliary power and make-up water. The generators will be outdoors. Two half-capacity, 8,000-rpm boiler-feed pumps, also outdoors, will be connected to the generator shafts through hydraulic couplings and speed increasers. The unit will connect directly to the 230-kv transmission system through a single transformer, and its load will be allocated by an automatic load dispatching system.

The objectives sought in automating Sewaren Unit 5 are to:

1. Guard against catastrophes
2. Minimize fuel costs
3. Contribute to a better system economy
4. Reduce outage time
5. Make personnel requirements

CONTROL ROOM of Sewaren Unit 5 is shown in design mock-up state. General view shows operator at computer console controls on recessed panel at left

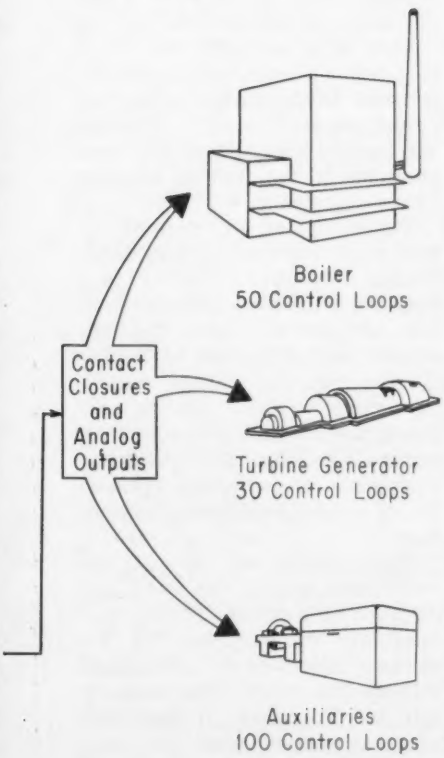


FIG. 1—FUNCTIONAL DIAGRAM shows flow of input and output quantities. The back-up scanner is integrated with the new unit's control system

TABLE I—Principal Data for Major Equipment Sewaren Unit 5

Boiler—Universal pressure with maximum continuous rating of 2,200,000 lb per hr at 2,483 psig, 1,100/1050F. Pressurized furnace with 24 burners divided equally between front and rear walls. Forney Engineering Co burner control.

Turbine-Generator—342 Mw at 1¼ in. Hg, 3,600/3,600-rpm cross-compound quadruple-flow turbine. Eight stages of feedwater heating. Two generators 208 Mva at 45 psig hydrogen, 0.85 pf, 18-kv, 0.64 SCR. Single motor drives both exciters.

Condenser—160,000 sq ft; single pass; 129,000 apm sea water circulation; ⅞ in.—18 BWG arsenical aluminum brass tubes.

Boiler Feedwater Pumps—Two half-capacity 8,000 rpm, generator shaft-connected through hydraulic couplings. A one-third capacity motor-driven pump for start-up, hydraulically coupled.

Forced Draft Fans—Two half-capacity with variable speed through hydraulic couplings.

Generator Step-up Transformer—400 Mva, 17.5-230 kv, 3-phase, FOA.

Computer—4,000-word core plus 48,000-word drum memory. Word length is 28 bits, with ability to operate on high and low order digits separately. Dual parity bit checking. Maximum addition time of 232 μsec; maximum multiplication time of 746μ sec. Electronic priority selection to eight levels. Power supplied by floating battery through inverter, with direct ac-feed back-up.

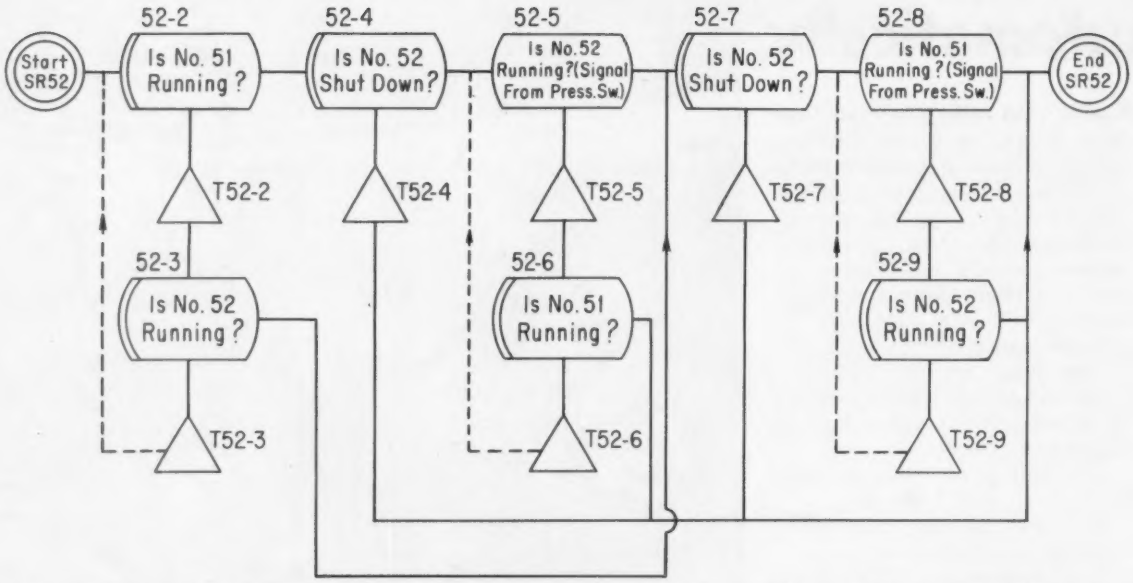


FIG 2—FLOW CHART of steps in unit start subroutine which tests for satisfactory operation of pumps and their control prior to service. Double lines on boxes signify computer will try to meet conditions

fewer for operations, calculations, and testing on the unit.

Lower maintenance requirements and a sound engineering basis for reducing instrumentation costs on future turbine generator units are anticipated also.

Accordingly, computer operation has been planned to accomplish the foregoing objectives in these ways. The computer will directly control the functions for starting the unit from a cold condition after preliminary manual steps have been taken by the operators. A hot start will be completely automatic. The computer will synchronize the unit and load it in accordance with an incremental-cost signal from the automatic dispatch system.

The computer will then adjust set points on the conventional control system so as to optimize operation. As a matter of routine, the computer will prepare performance reports and operating guides and will monitor plant conditions, log, and trend selected quantities. It will also take necessary corrective action, such as reducing load or even tripping the unit when off-normal conditions persist.

The computer will follow either a normal or an emergency shutdown routine, whichever is suitable, until the turbine is on the turning gear.

Once prescribed conditions for starting have been met, manual intervention will not be needed. Yet all controls and instrumentation for running the unit manually will be provided. Certain control switches will have a special position in which they must be placed for the computer to exercise direct operating control of the auxiliaries. Valving and switching for maintenance will be manual, restoration of normal conditions being a necessary prelude to the next start-up.

An operator at any time can override direct computer control by using a mode of operation in which the computer monitors but does not operate output devices. An independent back-up scanner, integrated into the computer system, will scan some 600 essential temperature measurements and give an alarm, when the computer is out of operation. The operator can then make corrections manually.

TABLE II—Set Points Adjustable by Computer

1. Combustion Control System, including load, pressure, feedwater flow, fuel, air, and steam temperature.
2. Excitation
3. Turbine Speed

The unit is expected to be on the line in 3½ hr from a cold start and capable of carrying full load in 5 hr. A hot start should enable the unit to be on the line in a mere 15 min. In normal operation, the rate of load change will be about 9 Mw per min. In emergencies, such as the loss of an auxiliary, the rate of load drop will be as much as 80 Mw per min. Initial conditions, such as proper oil level, must be checked and found satisfactory by the computer before the start-up program can be executed.

The computer will control the unit when the fuel fired is either Bunker C or residual fuel oil, or a mixture of the two. Fuel selection will be manual. After light-off, normal starting fuel will be Bunker C. The computer memory and input-output facilities can be expanded for conversion to coal firing without limiting the automatic equipment in controlling, optimizing, or making performance calculations.

The computer will calculate the boiler heat rate by the losses and input-output methods. Turbine heat rates will be calculated by the methods described in the ASME Turbine Test Code. The computer will be programed to determine where deviations occur and constantly move actual performance

closer to desired values by adjusting excess air, primary and reheat steam temperatures, burner configuration, gas recirculation, furnace and reheat-tempering dampers, turbine-valve throttling, and use of auxiliaries. In general, adjustments will be made by changing set points on the conventional control systems.

Three types of input devices will supply information to the computer. The electrical analog signal will be supplied to the analog-to-digital conversion equipment from thermocouples, resistance temperature detectors, transducers which sense pressures and flows, slide-wire position controls, Hall converters, and vibration amplifiers. Other inputs will come from contact-making devices for supervisory information and status of equipment. A third source of input will be pulse generators on meters measuring fuel, oil, watt-hours, and gland flow.

Plans are to use 1,127 analog, 431 contact, and nine pulse-counter inputs. The original estimates were that these inputs would be 1,024, 512, and five, respectively. Operating devices for utilizing output signals from the computer will be 279 contact closers for on-off type devices and stepping motors as well as 28 analog voltage output signals for positioning servomechanisms.

The scanning rate of the sensing devices will be programed for each variable, so that changes can be detected as rapidly as control action is required. Contact inputs will be read as frequently as once per sec. Status of auxiliary equipment and burners in service will be frequently-read contacts. Analog inputs will be read as often as every 2 sec, one such input being the turbine speed during start-up. Quantities such as the oil level in the residual fuel tanks will be read only once in 30 min.

(*Continued on page* 104)

TABLE III—Unit Trips by Sub-loop Control

Condition	Sensing Devices
Turbine-generator overspeed	1—hydraulic pressure switch
Turbine thrust bearing clearance	1—hydraulic pressure switch
Turbine-gen bearing oil low press	1—pressure detector
Turbine-gen governor oil low press	(Loss of pressure trips (automatically)
Turbine low vacuum	1—bellows switch
Generator differential	1—electrical relay
Generator ground	1—electrical relay
Generator loss of field	1—electrical relay
Generator out of step	1—electrical relay
Generator overcurrent and under-voltage	1—electrical relay
Overall differential	1—electrical relay per phase
Stuck 230-kv breaker	1—electrical relay per phase
Aux transformer differential	1—electrical relay per phase
Aux transformer ground	1—electrical relay
Low feedwater flow	1—pressure switch
Loss of windbox differential	1—pressure switch
Forced draft fans both tripped	1—electrical relay
Gas recirculating fan trip	1—electrical relay
4-kv voltage loss	1—electrical relay
Unit trip switch	1—manual switch
Emergency shutdown stations (2)	2—manual switches
Rapid loss of burners	1—output from control
Critical flame out	1—output from control
Low main steam pressure	1—pressure switch

TABLE IV—Unit Trips by Control Computer

Computer will not initiate any unit trips when in the "Monitor Only" mode of operation.

Condition	Sensing Devices
Turbine-gen low oil level in reservoir	3—float switches
Turbine-gen excess shaft vibration	3—vibration sensors per bearing
Turbine-gen main bearing, high temp.	3—thermocouples per bearing
Turbine-gen thrust bearing, high temp.	3—thermocouples per bearing
Turbine-gen main bearing, high rate of temp rise	3—thermocouples per bearing
Turbine-gen thrust bearing, high rate of temp rise	3—thermocouples per bearing
Hydrogen purity below 85% with rate of decrease less than 1% per 10 min	1—pressure transducer
Main steam temp above high limit	6—thermocouples
Main steam temp, high rate of rise above nomal limit	6—thermocouples
Main steam pressure below 1,200 psig	4—pressure transducers
Reheat steam above high limit	4—thermocouples
Reheat steam high rate of rise above normal limit	4—thermocouples
Economizer inlet flow below 660,000 lb per hr when firing boiler	3—differential pressure transducers
Makeup over 10% and hotwell level decreasing	2—limit switches and 1—level transducer
Feedwater conductivity above 8 micromhos	3—conductivity cells
Main transformer, oil level low	3—level switches
Main transformer, winding temp high	1—RTD, 1—thermocouple, and 1—CT
Aux transformer oil level low	3—level switches
Exciter bearing, temp high	3—thermocouples per bearing
Exciter bearing, high rate of rise	3—thermocouples per bearing
Turbine exhaust temp above 250F	3—thermocouples per shaft
Exciter motor, winding temp high	3—thermocouples, one per winding

4.16-Kv Primary Serves New

Grounded primary distribution permits good protection with ground relays. Serving utility helps coordinate relaying and tripping times from 480-v motor controls to source breakers on incoming 69-kv supply

B. K. KANGA, Electrical Engineer, Vern E. Alden Co, Engineers, Chicago, Ill.

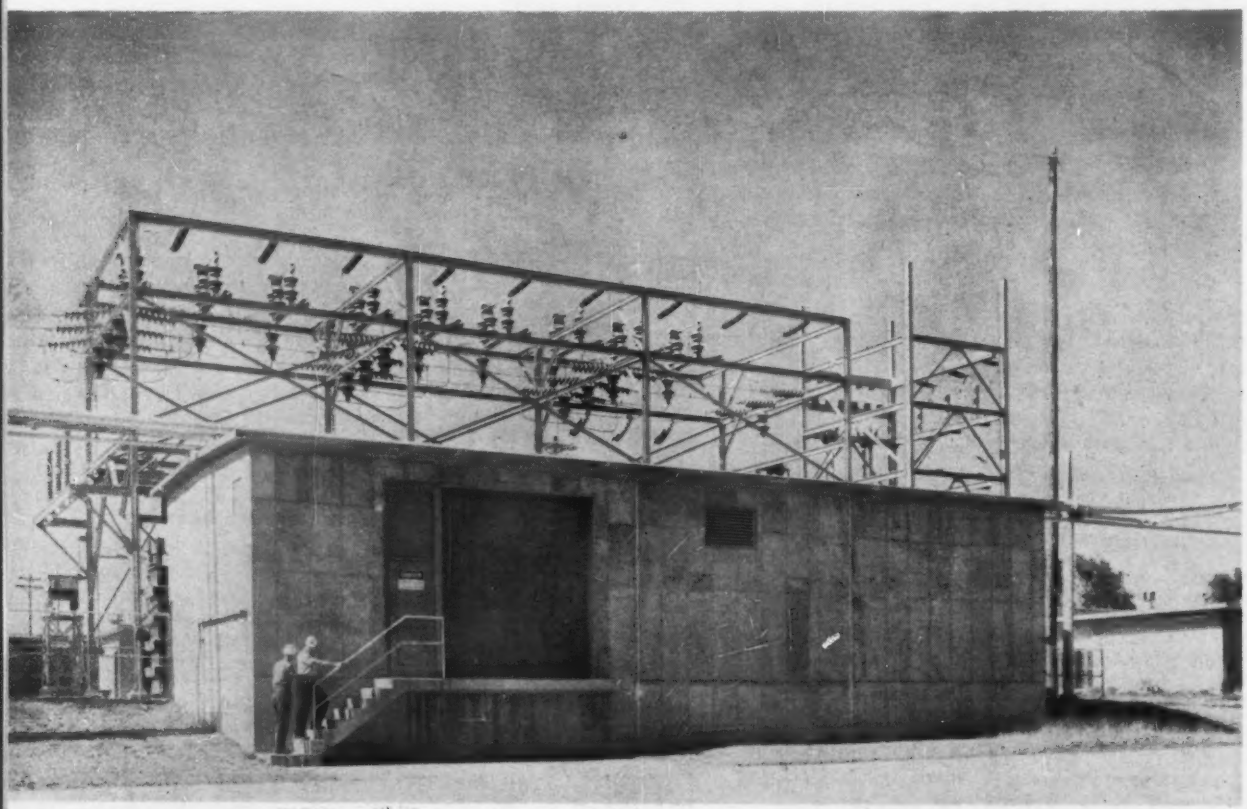
Expansion of the Ada, Okla., plant of Ideal Cement Co called for the modernizing and increasing of the power supply. Electrical power needs for the new plant are met by the installation of a 4.16-kv, wye-connected, resistance-grounded primary distribution system with a solidly-grounded 480-v secondary system. The grounded primary system allows good protection using ground relays, thereby eliminating damage to equipment by high voltages due to arcing grounds during a fault on the system. It also provides better protection for plant personnel.

A new plant, built next to the existing plant, consists of two units of a raw mill, kiln, cooler and finish mill. Total output of the wet-process plant is 10,000 bbl per day. Ultimate plans at the Ada site provide for two additional units. Estimated load of the two new units is 10,000 kva. The old plant has a load demand of 9,000 kva. A 2,500-kva load at the nearby quarry is served over a 33-kv line from the cement plant.

Studies showed that a primary distribution system at 4.16 kv would be more economical than expansion of the 2.4-kv and 480-v systems serving the older plant. Power is taken through a 69-4.16-kv substation consisting of three 3-phase, 7,500/9,375-kva, OA/FA, delta-wye transformers.

The power company's substation, located near the load center, will not interfere with future plant expansion. Arrangement of the plant lends itself to a simple radial distribution system. With separate feeders to each process department, failure of a feeder to one department will not affect production in others. Separate feeders also permit metering of power to individual departments for better cost accounting.

Feeders from 4.16-kv buses on the substation transformers are served through drawout air circuit



PRESSURIZED BUILDING houses switchgear for 4.16-kv feeders from buses on two main transformers to prevent contamination by cement dust and thus minimize maintenance. Interior of this switchhouse is shown on p 60

REMOTE CONTROL OF ALL OPERATIONS is provided from a centrally located control board. Proper sequence of operations and positions of devices are shown by indicating lights. Important electrical loads are shown on ammeters calibrated in appropriate quantities. Closed-circuit television allows operator to inspect kiln interiors. Equipment failure sounds alarm on control board

breakers in a pressurized switchhouse adjacent to the substation. Metal-clad switchgear minimizes the chances of a fault on the 4.16-kv bus. Three-phase breakers prevent the single-phasing of motors. Switchgear can be extended and a bus-tie breaker can be added when the third transformer is installed.

One 4.16-kv circuit goes to a 2,500-kva, 4.16-33-kv transformer, just outside the switchhouse to feed the 33-kv overhead line to the quarry. Two 5,000-kva, 4.16-2.4-kv OA transformers supply the existing plant. All feeders from the switchhouse to cement plant loads are underground. Also, underground feeders will not be disturbed by the moving of heavy equipment for the repair of kilns and mills.

Feeders are single-conductor, 5-kv butyl-insulated, neoprene-jacketed, shielded cables in underground asbestos-cement conduits encased in concrete. Those for 480-v circuits are single-conductor, 600-v insulated type RH-RW cables with neoprene jacket. All control cables are multi-conductor, color-coded, polyethylene-insulated cables with PVC jacket. Silicone-rubber-insulated cables were used where the ambient temperatures are very high. Special shielded cables or BX cables provide electromagnetic shielding as required on instrumentation or control cables. All cables are in exposed galvanized rigid steel conduits or in asbestos-cement conduits encased in concrete.

Motors ranging from 250 hp to 2,000 hp are served at 4.16 kv, with the largest—2,000 hp synchronous motors on the ball mills—started across the line through air circuit breakers in the switchgear. Separate control panels for synchronizing of the ball-mill motors automatically apply the dc field at correct speed and rotation. If the sequence is incomplete, the motor is tripped. Air-break starters with current-limiting fuses are used to start the other 4.16-kv motors.

Primary circuits feed load centers through 4.16-kv-480-v units substations equipped with 5-kv disconnect switches. Overload protection for load centers and back-up protection for the 480-v feeders are provided by 480-v main air circuit breakers. Short-circuit protection for load-center transformers is provided by main air circuit breakers in the 4.16-kv switchgear rather than by fuses at the transformers. This scheme precludes improper coordination between breakers and fuses.

480-V ACB Favored

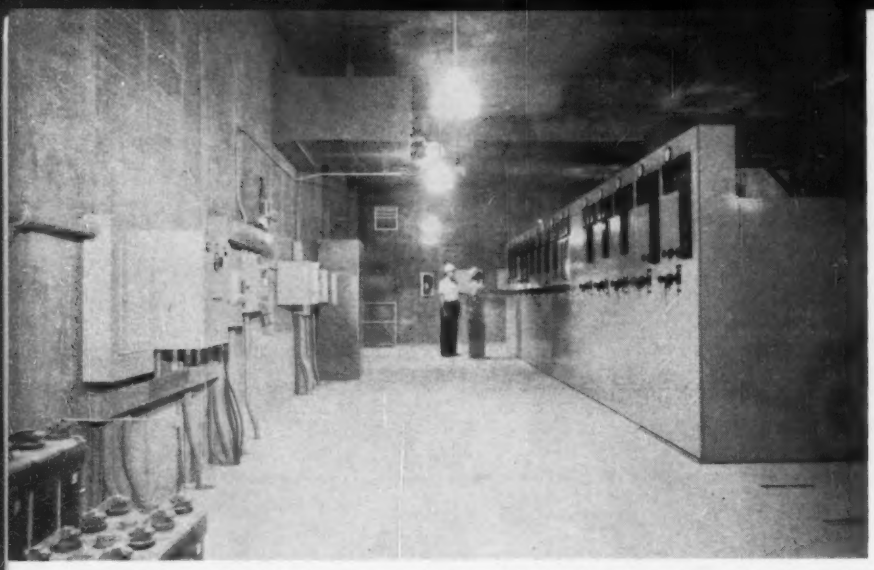
Electrically operated 480-v air circuit breakers control all 480-v motors larger than 100 hp and the more important motors of lower capacity. These breakers have proved more economical and reliable than combination starters. Feeders to motor control centers are protected by manually operated air circuit breakers. All other 480-v motors 100 hp and smaller are controlled by combination across-the-line motor starters with air circuit breakers.

Unit substations, motor-control centers and other electrical control equipment are in separate pressurized rooms close to the centers of load for each process. This prevents contamination from cement dust. Where necessary, motor-control centers were located away from the unit substation and near the load center in a separate room. In motor control centers fed from 1,000-kva unit substations, reactors will limit short-circuit current to 15,000 amp, the rating of the control center.

The 2,000-hp ball-mill motors are 4-kv, 0.8-power-factor, synchronous motors which provide power factor correction for the entire plant. High starting current of these motors, 550-650% of full-load current, heats up the starting winding. Therefore, the number of times a motor may be started in a 15 or 30-min interval was specified and the starting winding was designed to meet that requirement.

Controls of the 250-hp, 4-kv, wound-rotor induction motors driving the 1,100-ft inclined conveyor were specially designed to limit starting and accelerating torques to predetermined values with a five-step accelerator. All other 4-kv and 440-v motors are squirrel-cage induction type with torque characteristics selected on the basis of the loads.

An m-g set having a 440-v motor drive and a 250-v dc generator supplies the dc motors driving the kiln, slurry feeder and dust feeder. Speeds of the motors driving these equipments thus can be changed simultaneously by varying the field on the dc generator. Similar package drives are used for the clinker cooler and the pulsating air damper. Drives for material feeders from the silos are potentiometer-controlled so that drive speeds can be varied



FEEDER SWITCHGEAR is metalclad to minimize the chances of a fault on the 4.16-kv bus. Three-phase breakers prevent the single-phasing of motors. Switchgear can be extended and a bus-tie breaker added when a third main transformer is installed. All outgoing 4-kv feeders are underground in conduit

individually or simultaneously and in the same proportion to each other.

Manufacturing operations are all remotely controlled from a bench-type main control board which is centrally located to give the operator a view of mills and kilns. Control and instrumentation are all electrical. All process equipment is electrically interlocked so that equipment starts and stops in sequence. Failure of any equipment automatically stops the process flow into that equipment and gives an alarm or indication at the main control board. Local push buttons are provided for safety and for maintenance. A "manual-off-automatic" selector switch for each motor is in the control center.

To keep the control board to reasonable size, one set of push buttons controls a number of motors in one process sequence. Selector switches permit the selection of one or more pieces of equipment from a group or the by-passing of certain interlocking at start-up, shut-down or in emergencies.

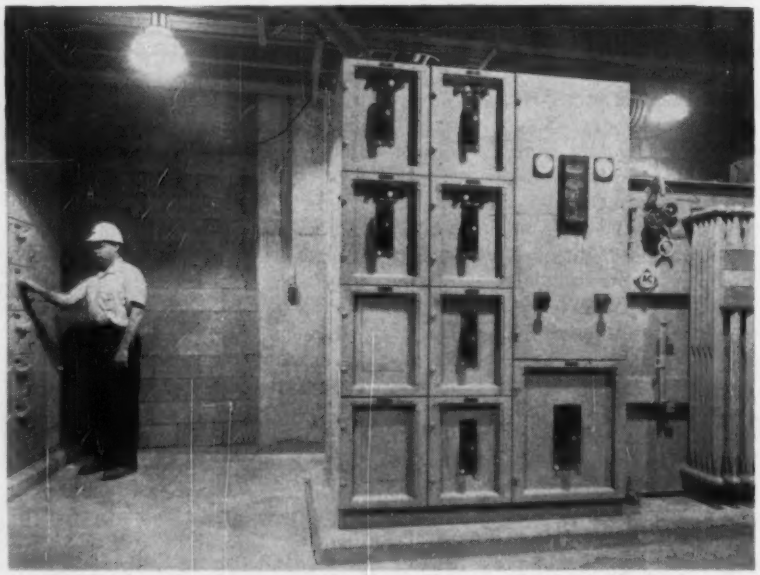
Motors for the ball mills are protected against internal faults by differential relays, with overload protection provided by thermal overload relays. Phase overcurrent relays and ground overcurrent relays provide back-up protection, required because fuses are used on lines supplying the 69-kv substation.

Should high speed reclosing be provided on the incoming 69-kv system, it will be necessary to trip and clear the synchronous motors within 18 cycles. High-speed underfrequency relays will provide 18-cycle clearing of these motors to prevent damage to them should they be too far out of phase upon reclosing of the incoming breakers.

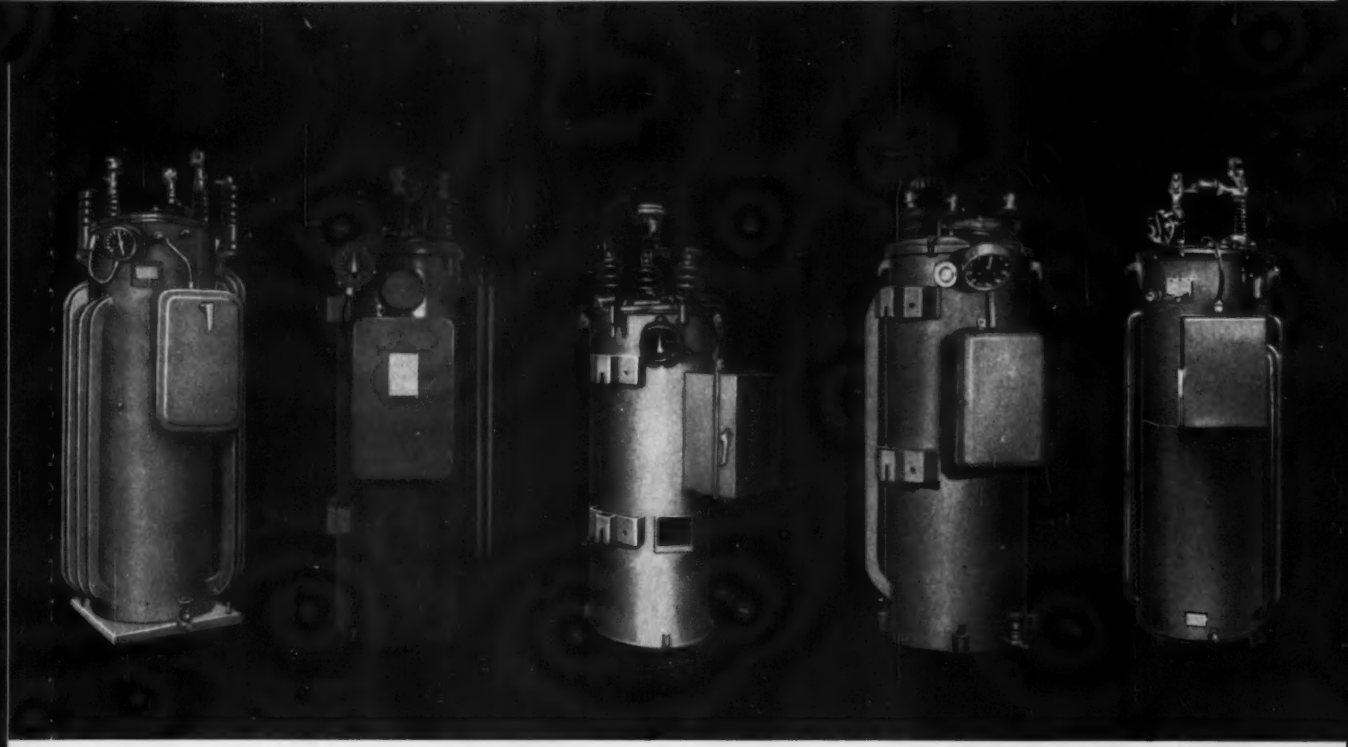
Main transformers at the substation are protected by differential relays and by phase and ground overcurrent relays. A transfer-trip scheme using a solenoid-operated grounding switch trips the breakers at the source of the 69-kv supply line.

Feeder and main circuit breakers are controlled by phase and ground overcurrent relays. All relays and circuit breaker tripping times are coordinated from the 480-v motor controls to source breakers on the 69-kv supply line. This was accomplished in cooperation with the Oklahoma Gas & Electric Co, the utility serving the cement plant. All major electrical equipment is grounded to a complete grid for the entire plant. Small motors are grounded through their respective conduits.

To keep kilns turning at low speed during power interruptions and to supply emergency lighting and some instruments and controls, there is a 100-kw, 40-v three-phase diesel engine driven generator. The operator at the control board can start the generator in case of approaching storms or impending trouble. The emergency-drive magnetic clutch and the main drive for the kilns are interlocked so that only one can be energized at a time.



UNIT SUBSTATION equipped with 5-kv disconnect switches feeds 480-v load centers. Motor-control centers are located either in the pressurized room with the unit substation or nearer the load center in a pressurized room



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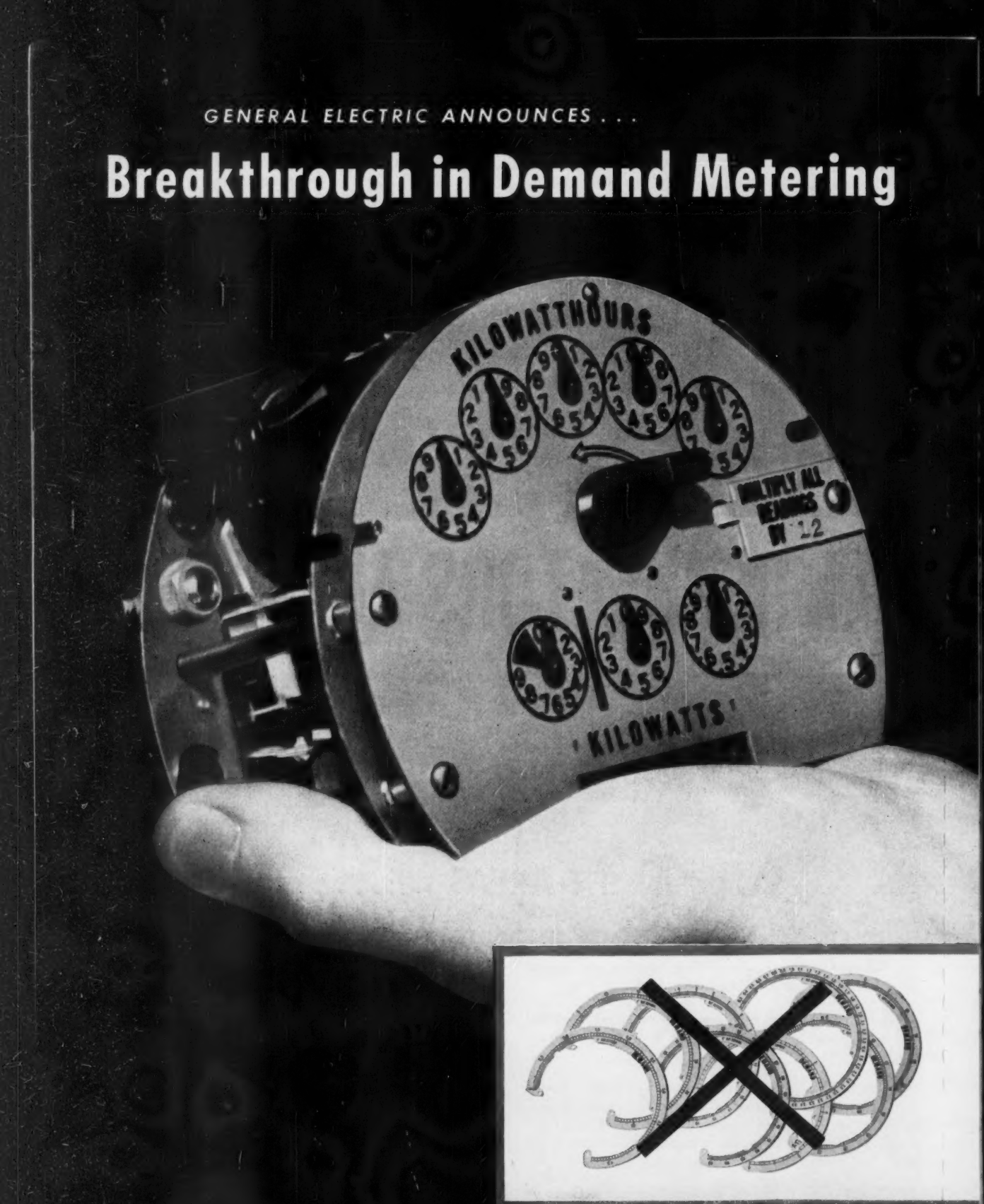

YOU ELIMINATE the cost and confusion of over 120 scale plates with new, exclusive three-dial demand indication of General Electric's M-60 register. Twenty times longer scale length gives unmatched readability. Readings are faster, more accurate, increase revenue.

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You slash inventory costs. Exclusive three-dial demand indication completely eliminates more than 120 scale plates . . . provides 190-inch effective scale length—20 times longer than any register—makes the M-60 a true universal register with extended load range capacity and highest known resolution for maximum application flexibility, lower inventory.

You cut replacement cost 50%. Test-proved 25-year service life of timing motor is double that of any register . . . for the first time matches register life with watthour meter life.

You reduce maintenance costs. No calibration adjustments required . . . new magnetic interval reset provides positive reset automatically. Timing motor requires no maintenance over 25-year service life.

You reduce reading errors. Direct reading of demand information reduces required reading skill, eliminates confusion caused by varying scale plates . . . readings are faster, more precise.

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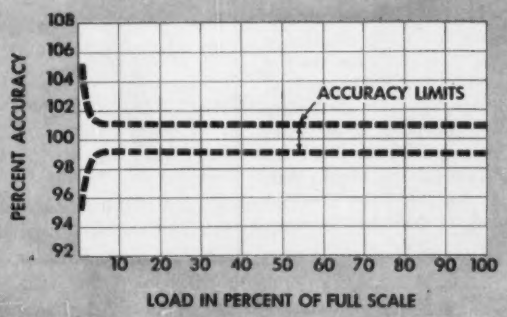
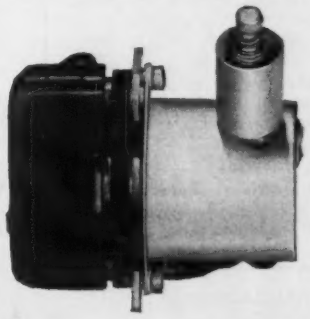


NEW GENERAL ELECTRIC M-60 demand register measures the majority of loads within a fraction of a kilowatt . . . ±1% at all KW values above five percent of register capacity. Accuracy is not related to full scale value, as present registers are.



NEW TIMING MOTOR has test-proved service life of 25 years. Complete unit—3600-rpm hysteresis rotor and Geneva gear train—is hermetically-sealed in tinned-copper case filled with silicone oil lubricant. Operates indoors or outdoors in all climates.

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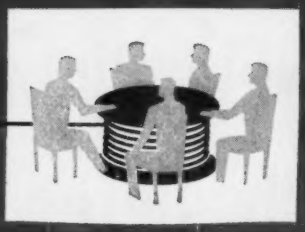

You have asked...

Q: What is the straight story on the flammability of polyethylene?

A: Polyethylene is rated as a "slow-burning" material, like rubber and many other materials. Its performance in flame tests depends on the construction. For instance, #6 AWG copper line wire with 2/64" of ALATHON 5, BK22 polyethylene resin passes the horizontal flame test. If you need a truly "self-extinguishing" insulation which will pass the U/L vertical flame test, use Du Pont RULAN flame-retardant plastic (based on polyethylene).

Q: What is the best nylon and best polyethylene for outdoor service? How long will they last?

A: The best outdoor nylon is ZYTEL 37X nylon resin. It contains well-dispersed carbon black, and a good heat stabilizer. We do not know yet what its outdoor life will be, but it has stood up over 17,000 hours in the Weather-O-Meter (unfiltered arc) without failure.

ALATHON 1000 BK-30 is Du Pont's best polyethylene resin for outdoor service. It should be good for well over 20 years (possibly over 40).

Q: I have had trouble with thermoplastic jackets splitting and jamming conduits during pulling. Do you know a good lubricant?

A: Maybe you're using the wrong thermoplastic. We are having great success with jackets of ZYTEL 37X. This product is extremely hard and slick, exceptionally tough, easy to pull. 37X looks good for direct burial cable, too, where you have especially tough plowing conditions.

Du Pont does not manufacture wire and cable, but supplies thermoplastic resins for insulation and jacketing.

Save 20-35% installation space with Du Pont plastics

Extensive research has shown that the properties of ALATHON polyethylene resins permit a thinner primary insulation with equal or better dielectric performance than other compounds. Result: smaller over-all cable diameter and smaller conduits are practical. Depending on the number and size of conductors, savings of 20% to 35% in thickness over the older constructions are thus possible.

For extreme cases, where the possibility of fire precludes the use of polyethylene, Du Pont recommends the use of RULAN, a flame-retardant plastic, in the same thickness as ALATHON. For secondary insulation, a thin skin of ZYTEL nylon resin imparts exceptional abrasion resistance and higher operating temperature limit. Where mechanical abuse or chemical attack pose a problem, an armor of ZYTEL gives maximum protection.

A typical control cable design that takes advantage of the superior properties of Du Pont plastics is shown at right. For complete information on the use of ALATHON, RULAN and ZYTEL for improving signal and control cable design, send for your copy of Polychemicals Department Booklet EI-6 "Signal and Control Cable Design." Write: Du Pont Company, Rm. EW11, Polychemicals Dept., Wilmington 98, Delaware. *In Canada:* Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.

POLYCHEMICALS DEPARTMENT

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ELECTRIC UTILITY METHODS

OPERATIONS & TESTING

Simple Detector Spots Crossed Conductor

S. E. WILSON, Test Engineer, Atlanta (Underground) Division, Georgia Power Co, Atlanta, Ga.

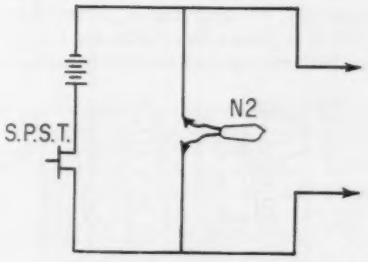
A lightweight, inexpensive, shop-fabricated, portable device is being used by Georgia Power Co to detect crossed cables on underground transformer installations using multi-set cables.

Accidentally crossed conductors pose a constant threat because the conductor sets are normally connected in the vault by Georgia Power crews and connected to the customers' bus bars by private contractors not under the utility's supervision. The usual installation has no points which can be easily opened for test.

Because the dc resistance of 125 and 480-v underground transformers' secondaries is so low, dc ohm meter readings would not offer a positive method of crossed conductor detection. Crossed conductors would of course constitute a low resistance short on at least one low side winding, making that particular bus to bus inductance zero. To prove the cable installation correct, it is necessary to detect the transformer inductance between bus-bars.

The shop-fabricated detector which will quickly prove-out an installation was constructed by Georgia Power's R. C. Bell. It is economically fabricated, consistent, self-powered and portable. With all parts contained in a 3x4x5-in. metal box, the unit is powered by three standard "D" flashlight cells.

In use, the detector is connected to the customer's bus bars prior to bank energization, and the switch, as indicated in the schematic diagram, is depressed. When the switch is released after the bank is energized, the transformer inductance will cause the N-2 bulb to "wink" with a bright unmistakable glow if the conductors are connected correctly. If any conductors have been crossed or any accidental "short" or "open" exists, the light will, of course, not "wink." It should be noted that the detector will not ordinarily work if the transformer high side is shorted.



Snow Tractor Insures Snow Patrol

Snow storms this coming year won't prevent Public Service Co of Colorado from patrolling transmission lines over and in the vicinity of the Continental Divide—thanks to snow-top-travelling tractors. Experience gained last year during heavy storms in Cheyenne, Wyo., proved to the company's satisfaction the ability of the "Trackmaster" for snow patrol work and emergency repair in rough terrain.

Two versions of the snow tractor are used: the narrow-frame, wide-track model for maximum flotation in deep, soft snow; and the wide frame for maximum load-carrying over bare ground. The tractors can carry the driver plus a passenger plus 1,500 lb of cargo—has a 130-hp engine, and travels atop the snow at speeds up to 35 mph.

Growth Factor Extends Loss Evaluation to

R. A. DEWBERRY, Electrical Engineer, Montana-Dakota Utilities Co, Minneapolis, Minn.

Cost of losses on a distribution feeder over its expected service life can be determined from convenient loss equations by applying a factor for growth in feeder kva. And the losses for both express and uniformly-loaded circuits can be computed from feeder load factor rather than the loss factor without appreciably changing the accuracy for load factors from 0.2 to 0.8.

Derivation of the service-life loss equations assumes that all factors remain constant except feeder kva, which is assigned a constant growth rate. While the resistance, length and voltage of a given feeder will generally remain constant over its life, the load factor and cost of energy may change, usually upward. But any upward change in these assumed constant values will make values computed for service-life losses more conservative. Accordingly, the equations as derived provide a valuable basis for weighing the cost of losses against the cost of owning and maintaining the feeder during its expected service life.

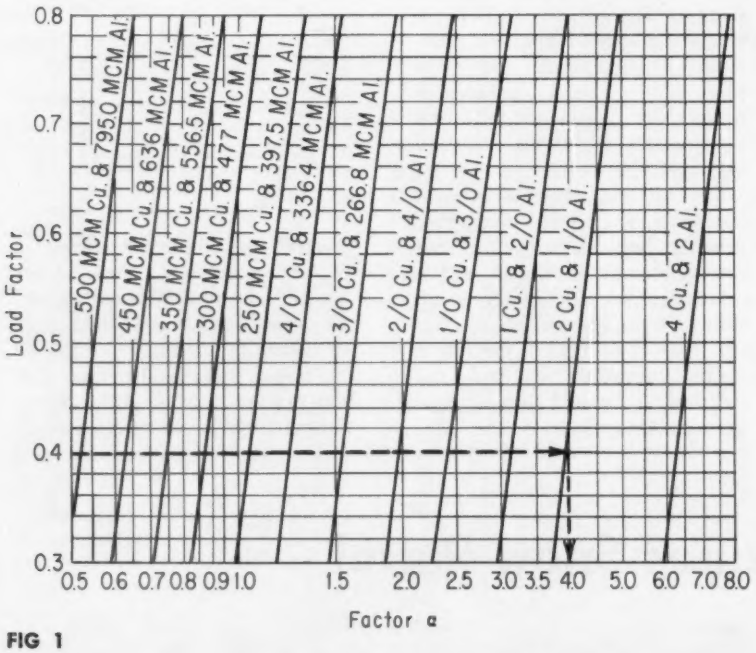


FIG 1

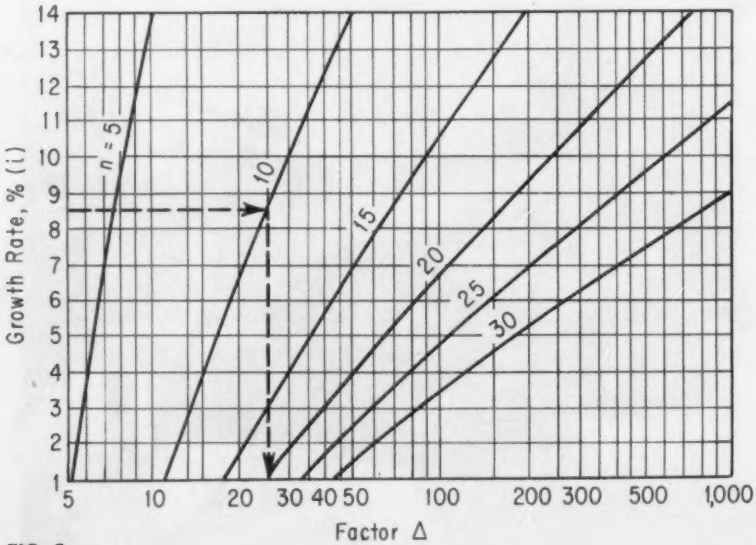


FIG 2

Conventional formulas for annual line losses are given by these two equations for express and uniformly-loaded three-phase feeders, respectively:

$$Kwhr_{ef} = 8{,}760 \cdot 3F_e \left(\frac{kva}{\sqrt{3}\,kv}\right)^2 r_e L \cdot 10^{-3} \quad (1)$$

$$Kwhr_{uf} = 8{,}760F_e \left(\frac{kva}{\sqrt{3}\,kv}\right)^2 r_e L \cdot 10^{-3} = \frac{Kwhr_{ef}}{3} \quad (2)$$

in which $Kwhr_{ef}$ = annual losses on an express feeder,
$Kwhr_{uf}$ = annual losses on a uniformly loaded feeder,
r_e = conductor resistance per mile,
L = length of feeder in miles,
F_e = loss factor.

To convert these formulas to represent the total cost of losses during the entire service life of the feeder, it is necessary to find the average value of the factor, $\left(\frac{kva}{\sqrt{3}\,kv}\right)^2$, during a period of n years.

The term, $(1 + i)^n$, where i is the constant growth rate expressed as a decimal, can be applied to the initial kva loading to estimate feeder load n years in the future, according to the relationship:

$$kva_n = kva_o(1 + i)^n \quad (3)$$

in which kva_o is initial peak load and i is expressed as a decimal.

By substituting the value for kva_n from equation 3 for kva in the term, $\left(\frac{kva}{\sqrt{3}\,kv}\right)^2$, and by taking the average value for the n-year period, the factor for growth in feeder kva is determined:

$$\left[\frac{kva}{\sqrt{3}\,kv}\right]^2_{avg}$$

Feeder Life

$$= \left[\frac{kva_o}{\sqrt{3}\,kv}\right]^2 \frac{\int_0^n (1+i)^{2n}\,dn}{\int_0^n dn}$$

$$= \left[\frac{kva_o}{\sqrt{3}\,kv}\right]^2 \left[\frac{(1+i)^{2n}-1}{2n\log_e(1+i)}\right] \quad (4)$$

Now, by substituting the factor for average kva into equations 1 and 2 and multiplying by energy cost per kwhr and number of years, the cost of losses, C, during the n-year period is shown by these equations for express and uniformly loaded feeders, respectively:

$$C_{ef} = 8.76F_o r_o L r_1 \left[\frac{kva_o}{kv}\right]^2 \cdot \left[\frac{(1+i)^{2n}-1}{2\log_e(1+i)}\right] \quad (5)$$

$$C_{uf} = \frac{C_{ef}}{3} \quad (6)$$

in which r_1 is the cost of energy in dollars per kwhr.

Because the load factor of a feeder is generally more easily found than the loss factor, it is desirable to substitute load factor for loss factor. As developed by the author (EW, Oct. 17, 1960, p64), loss factor is approximately equal to (load factor)$^{1.6}$ for the usual range of values. This substitution is included in the simplification and rearrangement of equations 5 and 6 to yield:

$$C_{ef} = LF^{1.6} r_o r_1 \cdot 10^3 \left[\frac{(1+i)^{2n}-1}{2\log_e(1+i)}\right] \cdot \left[8.76L\left(\frac{kva_o}{kv}\right)^2 10^{-3}\right]$$

$$= \alpha\beta\Delta \quad (7)$$

$$C_{uf} = \frac{\alpha\beta\Delta}{3} \quad (8)$$

in which LF = load factor.

General Electric Co's *Distribution Data Book* gives a curve relating the cost of energy, r_1, and loss factor. With this and the relation, loss factor equals (load factor)$^{1.6}$ (EW, Sept. 4, p49), it is convenient to plot the relation between load factor and α for various conductor sizes. Such a family of curves is shown in Fig 1. Fig 2 relates Δ to load-growth rate for various service lives. Values of β are developed graphically in Fig 3 for present (initial) kva, voltage and length of feeder. Fig 4 performs graphically the multiplication of the three individual terms from the other three figures to yield the cost of losses during the period selected.

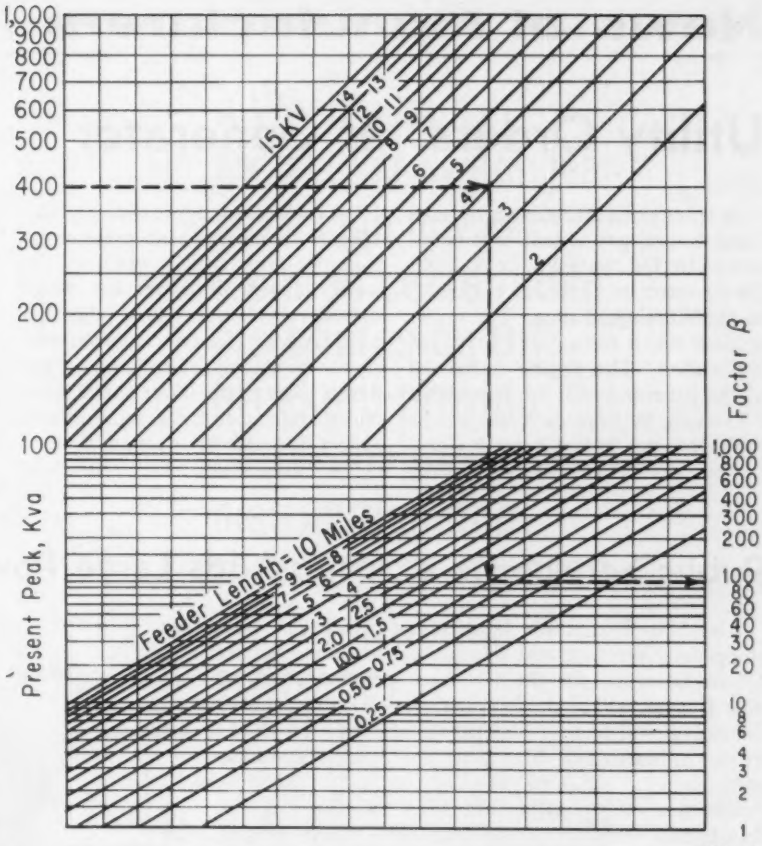


FIG 3

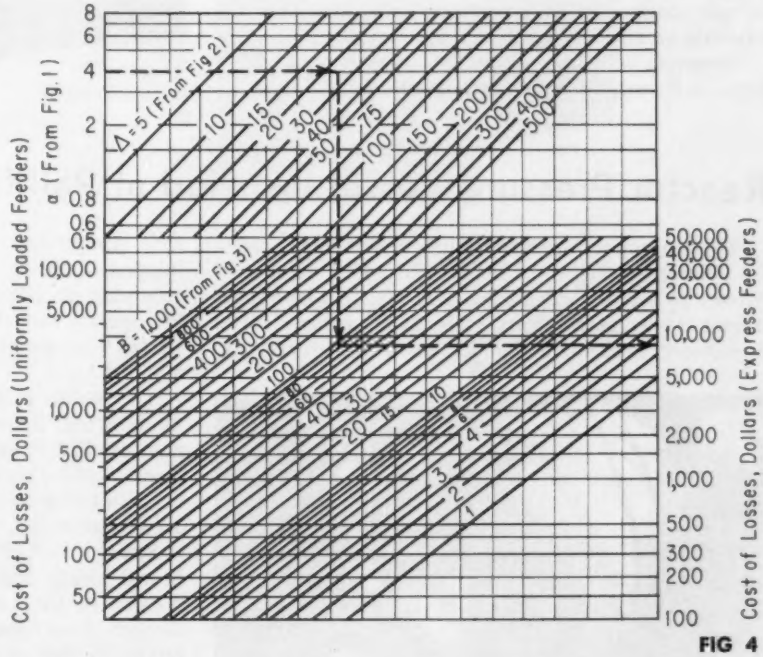

Δ = 5 (From Fig 2)
α (From Fig. 1)
B = 1,000 (From Fig 3)
Cost of Losses, Dollars (Uniformly Loaded Feeders)
Cost of Losses, Dollars (Express Feeders)

FIG 4

Illustration: Find the cost of losses during a ten-year period for a one-mile, three-phase, 4-kv express feeder. Conductors are No. 1/0 ACSR, load factor is 40% (r_1 = \$0.019 per kwhr), present peak kva is 400, and constant growth rate is 8.5%.

From Fig 1, the value for α is 3.9. From Fig 2, Δ is 25, and β, from Fig. 3, is 90. Entering Fig 4 with these values gives a total cost of losses for ten years of \$8,800.

Utility Orders et Generator

A jet-engined electrical generator, using natural gas as fuel, will be installed by Delaware Power & Light Co to serve its electrical customers in the Wilmington area. The utility believes this is the nation's first such application. The engine harnessed to the generator will be a modified J-75 made by Pratt & Whitney Aircraft Division, United Aircraft Corp.

The gas-turbine assembly, the FT-4, will weigh approximately 15,000 lb—compared with present stationary units which produce the same amount of power but weigh considerably more than this jet unit. Advantages over conventional power producing units cited by the manufacturer are lower installation and maintenance costs, more adaptability and shorter overhaul times.

The generating unit, which will produce 13.5 Mw, will be installed at DP&L's Edge Moor station as augmentation for the larger steam-operated plants now in use. It will be only 65 ft long, 10½ ft wide, with a basic height of 16 ft.

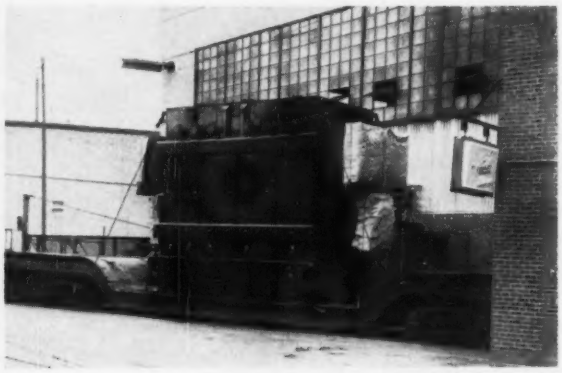
Hartford Electric Light Co also plans to have a modified jet-powered electrical generator for the Hartford Conn., area by mid-1962. This, a J-57, will produce 10 Mw.

Public Service Co of Colo. Adds Large Power Transformer

The 180-Mva power transformer, which has been shipped by Westinghouse Electric Co to Public Service Co of Colorado for the Cherokee generating station near Denver, will be the largest such unit on the utility's system. It will boost generated voltage from 14 to 114 kv for transmission throughout the Rocky Mountain area.

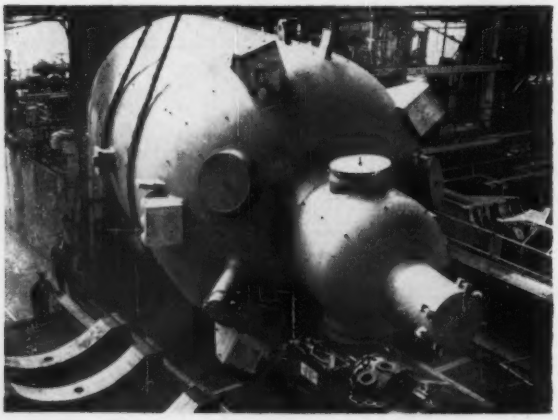
Shipment of the large unit from the Westinghouse transformer division to Colorado was made by rail, using a special depressed-bed flat car (see photo, right). It was transported as a complete unit, with only the external accessories removed for shipment.

Complete with accessories, the transformer is 21 ft high, 24 ft long, 14 ft wide and weighs 324,000 lb.



Reactor Pressure Vessel Installed at Pathfinder Atomic Plant

This 65-ton reactor pressure is shown being loaded for shipment from Allis-Chalmers Mfg Co's West Allis Works (Wis.) to Northern States Power Co's Pathfinder atomic power plant, Sioux Falls, S. D. Installation in September brought Pathfinder plant construction to 85% completion. All other major equipment has been shipped to the site and installed except for the 66-Mw generator, installation work on which is still in progress. Pre-operation system tests of the Pathfinder plant started last month, initial criticality is scheduled for mid-1962.



The reactor pressure vessel was moved into the reactor building, covered with 3 in. of thermal insulation and installed in the shielding cavity in three days. The three 20,000-gpm recirculation pump volutes have also been installed and piping connections to the reactor are being welded.

Strange configuration of nozzles to discharge superheated steam and recirculate core coolant mark the bottom of the vessel. Water will enter the reactor through three openings in the 4-ft-dia inlet section and return to the recirculating pumps through the three outlets on the bottom of the main reactor vessel. Pumps will recirculate 600-psi, 486-F water at 60,000 gpm through the reactor core. The reactor is thermally rated at 200 Mw. When in operation, superheated steam at 540 psi, 825 F will flow to the turbine generator.

Turbine Contract Awarded to English Electric

English Electric Corp was recently awarded a contract worth approximately $2½ million by Grand River Dam Authority for the design, manufacture and delivery of four 35,000-hp, 900 rpm, Kaplan water turbines. The equipment will be used for a new dam on the Grand River at Markham Ferry, Okla.

The turbines will be manufactured by an EE associated company, John Inglis Co, Ltd, of Toronto, Can. The turbine runners will be 220 in. in dia, and generally similar in type and design to the ten 114,000-hp units supplied by EE, which, with associated generators also made by EE, are in operation at Priest Rapids Dam, Wash.

Markham Ferry will be a gravity and rock-filled dam. The mean head will be 55 ft. As well as providing a measure of flood control, the project will supply the state of Oklahoma with an additional 100,000 kw. Consulting engineers for the project as a whole are W. R. Holway & Associates, Tulsa, Okla., who are also responsible for an earlier dam constructed by the Grand River Dam Authority at Pensacola.

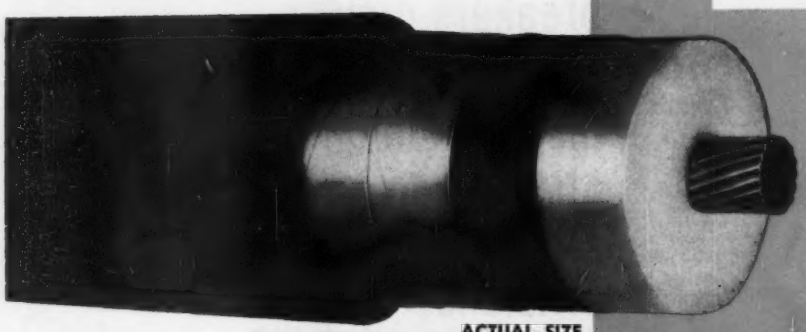
Customer Computer Service Bureau Opens

Minneapolis-Honeywell Regulator Co's electronic data processing division has opened a computer service bureau at division headquarters, Wellesley, Mass. It plans to establish a second bureau at University of Southern California in August. The Wellesley bureau is making an average of 300 program check-out runs a day, including customer programing aids. It is equipped with a $1-million Honeywell 800 electronic data-processing system, and early next year will have a Honeywell 400 system. The service bureau at the university also will have a Honeywell 800 system, shared by the bureau on part-time basis for educational purposes. At a later date, other service bureaus will be established elsewhere in the US and perhaps overseas, says Honeywell.

(*More News of Manufacturers, p* 71)

A Westinghouse Metal-Clad Switchgear advantage to you:
Isolated center coil arc chutes on DH breakers provide better magnetic field distribution and strength to increase arc interruption efficiency

For complete facts on Westinghouse metal-clad switchgear using DH magnetic air circuit breakers, contact your Westinghouse representative or write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.
You can be sure... if it's **Westinghouse**
J-61019



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EXECUTIVE OFFICES: Cambridge, Massachusetts • PLANTS at Cambridge, Massachusetts and Portsmouth, New Hampshire

MANUFACTURERS BRIEFS

• **General Electric Co** has received a record order from a Brazilian hydroelectric agency for 24 345-kv power transformers, from 50 to 225 Mva. GE officials believe this is the largest number of 345-kv transformers yet ordered and says the 1,600-Mva total electric capacity will be the highest for one order. All units are multi-rated, with self-cooled, fan-cooled and forced-oil-cooled ratings. The majority of them are single-phase and nine have load-tap-changing equipment.

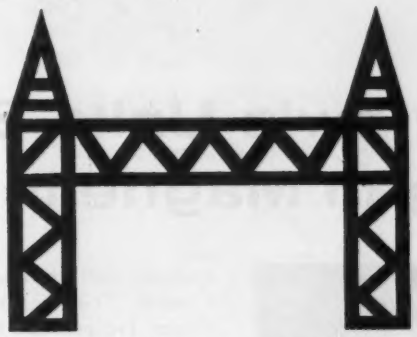
• **Sperry Rand Corp** will supply a Univac III electronic computer for installation in Houston Lighting & Power Co's main office in early 1963. Five departmental functions will be converted for handling by the unit: customers' accounting, payroll, stores, and dividend and transportation accounting. The general-purpose computer will also eventually be used by other departments, such as power, engineering and personnel. The most advanced solid-state circuitry and data-processing concepts are said to be incorporated in the unit, e.g., a new character-packing technique. This facilitates storing the same amount of information on a single reel of Univac III tape that used to require as many as 20 reels. This data can be read from the single reel of tape at a rate of 200,000 digits per sec.

• **Westinghouse Electric Corp** will supply, on a turnkey basis, two 11.3-Mw gas turbine-generator power plants for Sierra Pacific Power Co's Tracy substation, 17 miles northeast of Reno, Nev. The first is scheduled to go into service in mid-November; the second during the second half of 1962. The twin units are self-contained and controlled automatically.

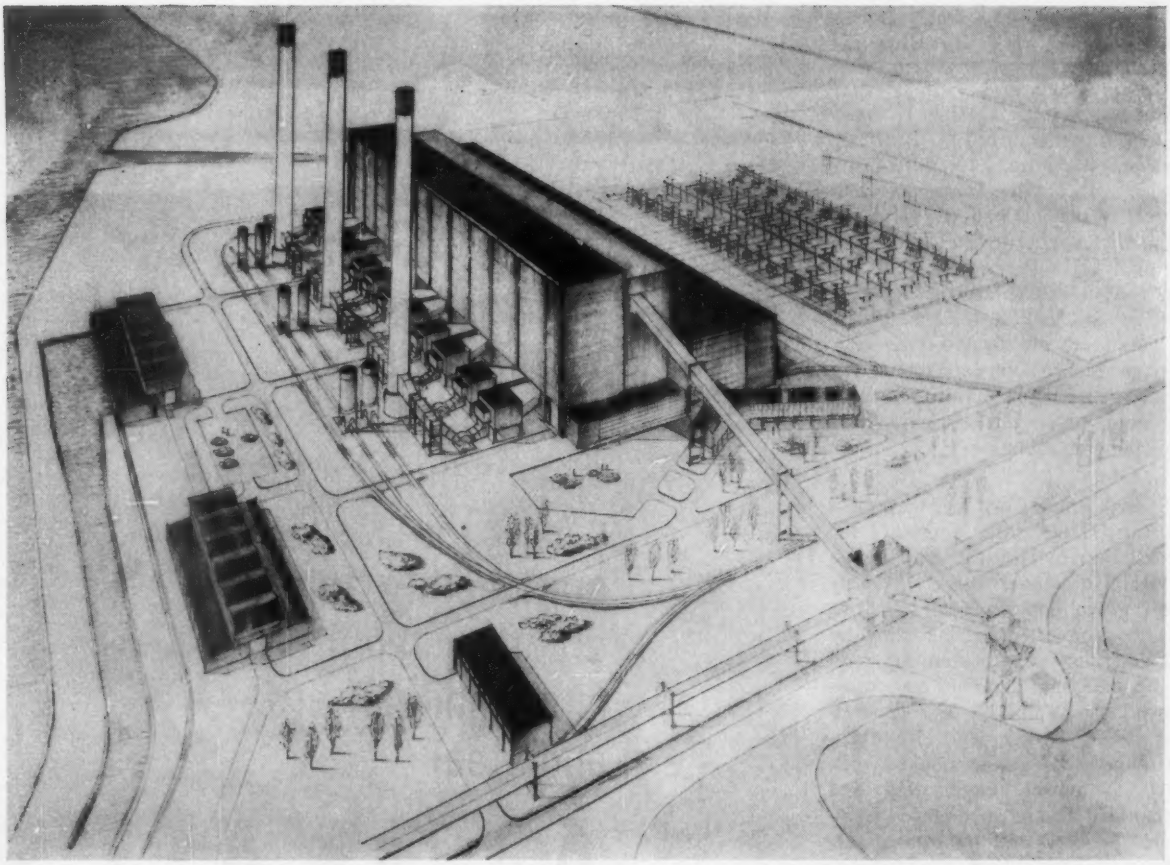
• **Line Material Industries** recently observed its 50th year in the manufacture of electrical products. Since its inception, it has extended its line to include a complete line of electrical distribution equipment, fibre pipe and conduit, all types of outdoor and street-lighting equipment. It has expanded from local to world-

(*Continued on page* 73)

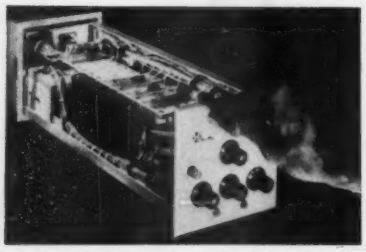
A Westinghouse Outdoor Substation advantage to you:
Modular design substations let you make valuable time savings in engineering and erection, require minimum plot area and steel



For complete facts on modular design outdoor substations, contact your local Westinghouse representative or write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.
You can be sure... if it's **Westinghouse**
J-61020



Lakeview's Units 3 & 4 first to have Hagan Magnetic Boiler Control



The Hagan PowrMag Unit slides easily out of its case so that control functions may be changed or modified. The plug-in strip seen at the top of the unit contains the resistors and capacitors that form the "passive network" which determines control action.

Controls for two of the largest single-furnace boilers ever installed in Canada will be Hagan PowrMag (magnetic amplifier). The Hagan systems will include Combustion Control, Feedwater Control and Steam Temperature Control.

The Lakeview generating station, now being built by The Hydro-Electric Power Commission of Ontario, will eventually add 1,800,000 kw to Ontario Hydro's capacity. The Hagan controls will be the first solid state electronic system used by a Canadian utility.

Hagan's PowrMag offers many attractive features for central station control. The basic controller is easily modified, by means of plug-in elements, to perform all control actions. This simplifies inventory and part stocking problems. PowrMag systems are accurate, simple and direct, there is no need for prolonged operator training periods.

The PowrMag line includes all the components necessary for a complete control system, including reliable, positive action, pneumatic final operators. A Hagan engineer will be glad to provide complete facts and operating details on the PowrMag system — designed for precise and economical power plant operation.

HAGAN
CHEMICALS & CONTROLS, INC.
HAGAN CENTER, PITTSBURGH 30, PA.

HAGAN DIVISIONS: CALGON COMPANY • HALL LABORATORIES • BRUNER CORP.

wide distribution of these products. The company has also served as national distributor of **Fargo Manufacturing Co's** electrical connectors for 32 years.

• **International General Electric Co, (IGE),** a division of General Electric Co, has been awarded a $23-million contract to build the first large central power station in the newly-formed state of Gujarat in India. Under a contract between the India Supply Mission of the Government of India and IGE, four 63.5-Mw turbine-generator units will be supplied by IGE to the Gujarat Electricity Board for a thermal station at Dhuvaran. This plant is located at the head of the Gulf of Cambay, north of Bombay. IGE also will supply associated mechanical and electrical equipment, plus design engineering services. Supervisory engineering and equipment installation services will be undertaken by IGE (India) Private, Ltd, under a separate contract with the Gujarat Electricity Board.

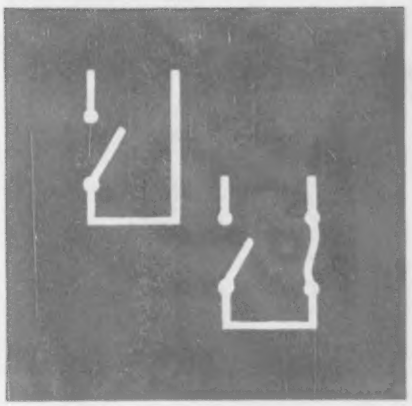
• **Babcock & Wilcox Co** recently was awarded a license which permits it to produce and sell welding fittings and flanges of Yoloy steel to match the Youngstown Sheet & Tube Co's piping of the same alloy. Thus, B&W will be able to provide a complete package of corrosion-resistant piping materials. Yoloy is an alloy which, according to an announcement by the two concerns, is lower in cost and resists corrosion better than wrought iron. It was developed by Youngstown.

• **Electric Storage Battery Co** and **Sun Oil Co** have signed an agreement for the exchange of research information and future cooperative development of fuel cells—expected to be mutually advantageous because of complementary exploratory work of the companies' research teams.

• **James Cunningham, Son & Co, Inc,** manufacturers of crossbar switches, has moved from downtown Rochester to just outside of the city, to new quarters, a newly constructed plant in Honeoye Falls, N. Y. The company's principal activity is the manufacturer of crossbar switches.

A Westinghouse Switchgear advantage to you:

Component selection in DFS drawout switch and fuse switchgear provides maximum application flexibility



For complete facts on DFS drawout switch and fuse switchgear, contact your local Westinghouse representative or write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.
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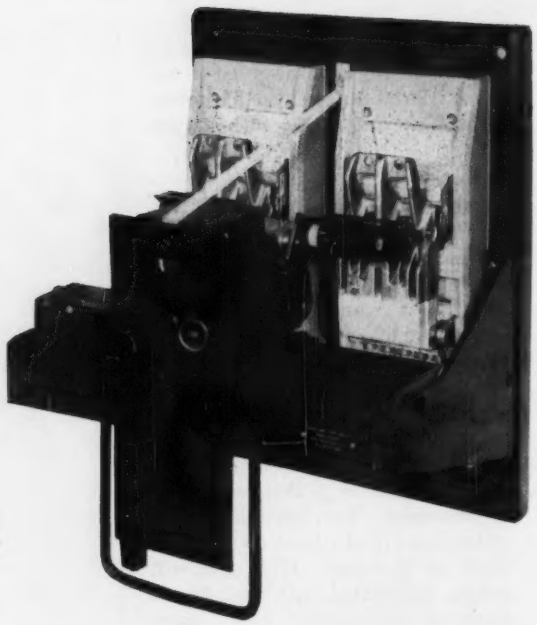
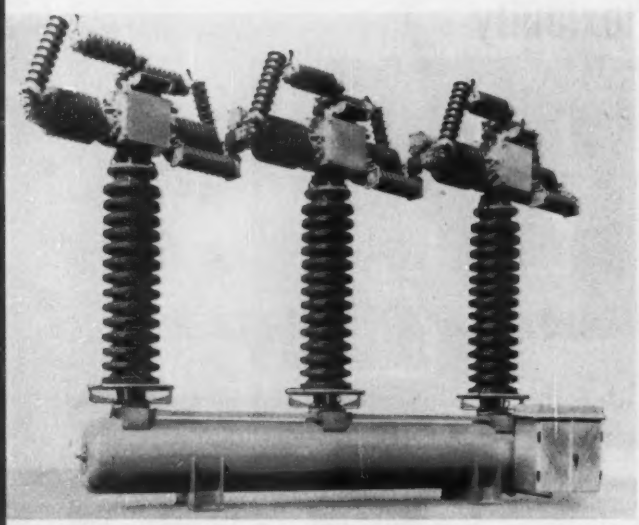
New Equipment



Disconnect Switch . . .

. . . for low-voltage, high-current service (Type DBDS) handles 1,000-v, 10,000-amp dc or 600-v, 8,000-amp ac. The easily operated steel-panel-mounted switch uses components from the DB circuit breaker line to eliminate the arc chute and arcing contacts of the circuit breaker assembly. The switch is closed by a rotary handle motion and opened by a trip button. Switch position indication is provided in the operating mechanism, and auxiliary switches may be provided if desired. Bus connections are made from the rear of the panel.
Westinghouse Electric Corp, Pittsburgh, Pa.



Air-Blast Circuit Breaker . . .

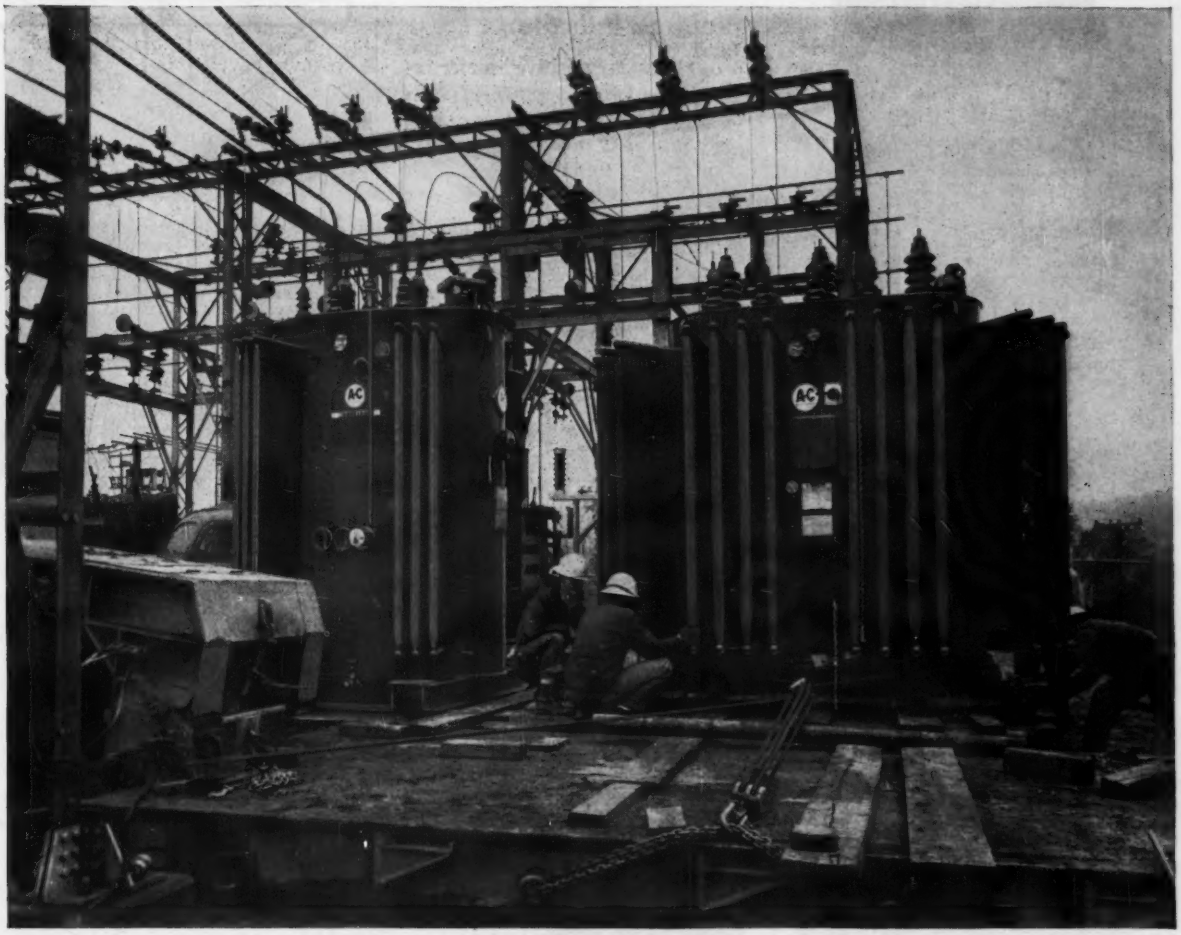
. . . has new range—from 132 to 650 kv, 2000 to 4,000 amp, short-circuit ratings up to 50,000/60,000 amp, with total break times of 0.05 sec. Frame "R" is manufactured from basic units which can be factory tested separately so the breakers need not be assembled for test when received, and so that various unit combinations give maximum flexibility throughout the range. Various ratings are met by using multiples of a unit interruptor, connected horizontally in series. Full air pressure for air blast is available at contacts immediately because contacts are fully pressurized constantly and blast valve is fitted downstream. Interruptors are built in pairs with one blast valve and control mechanism per pair, and consist of a cylindrical fixed main contact, housing a spring-loaded arcing contact and a moving throat—located in a second cylinder attached to the casting.
English Electric Corp, 750 Third Ave, New York

Portable Oil Tester . . .

. . . uses epoxy encapsulated high-voltage transformer construction to reduce weight and over-all size by more than 50% compared to previous models. The unit, for periodically testing the quality of oil in liquid-filled transformers and other electrical equipment, will operate up to 40-kv test voltage, compared to a maximum of 35 kv of former designs. It is rated 50/60 cycles, 120 v and designed in accordance with standards of the American Society of Testing Materials. Weighing only 42 lb, the tester is believed by the manufacturer to be the lightest truly portable oil tester presently available. It measures 7½x8½x15¾ in.
General Electric Co, Schenectady 5, N. Y.

(*More New Equipment on page* 76)

ALLIS-CHALMERS



New small power transformer increases station capacity from 2500 kva to 5000 kva with minimum alteration.

With new low-silhouette power transformer...

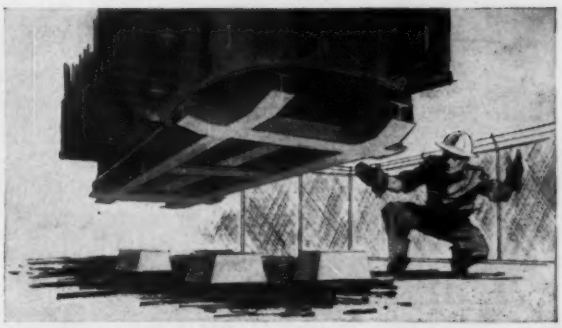
100% more capacity without raising "overhead"

West Penn Power Company installed this compact new A-C 5000-kva transformer to replace an existing 2500-kva transformer without raising the overhead structure!

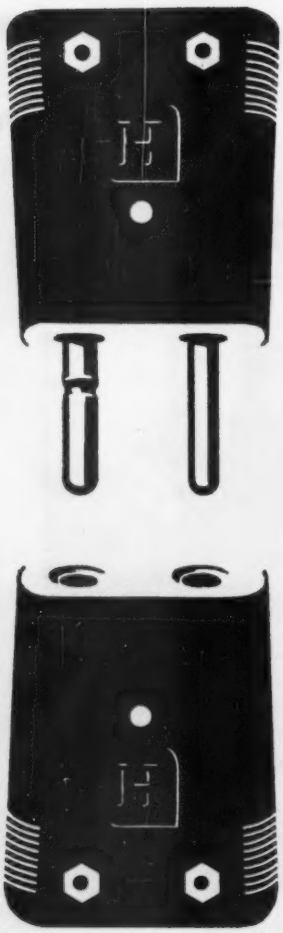
You too can solve rising substation load and space problems.

Now A-C units can replace your old transformers — deliver as much as a 30% increase in kva without any increase in unit size or weight! You never need alter your base mounting (no weight increase) or your overhead structure (no height increase).

These units, offered in 7500 kva, 69 kv and below, feature reduced losses, decreased exciting current and lower noise level. *Call your nearby A-C office for details or write* **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1438



New base design, reduced transformer weight cut foundation size and cost. No external tank bracing to catch dirt. Clean design makes painting easy.



QuiK-Konnect
PLUGS AND JACKS

New Honeywell QuiK-Konnect Plug and Jack Assemblies provide fast, foolproof connection of thermocouples to extension wire, and thermocouple extension wire to instruments. Inserts of different diameter positive and negative poles insure correct polarity every time. Inserts are easily removed for field calibration change or replacement, and can be furnished in different metals to match thermocouple alloy. Honeywell Quik-Konnect Accessories include identos, cable clamps, and tube adapters.

Get complete details from your nearby Honeywell field engineer, or write today for Specification Sheet FS 005-3. Minneapolis-Honeywell, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

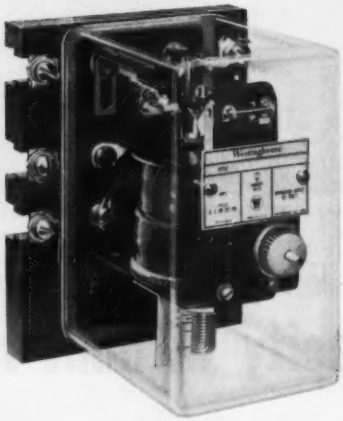
Honeywell

First in Control

SINCE 1885

Voltage Indicator . . .

. . . provides "positive" meter indication of the presence of voltage on energized power lines, without direct-wire contact. The Voltage Proximity Indicator (VPI) is an electronic proximity-sensing instrument which is especially designed for linemen and others working close to or in contact with known, unknown, or hidden, unshielded power lines. Its transistor circuits are actuated by the presence of the electrostatic field surrounding energized power lines. VPI distinguishes the hot lead from the ground lead, will trace and indicate location of circuit failure. It provides positive voltage indication for normal 110-v ac and higher, obviates clamping or splicing wire. **Wintronics, Inc, 213 S Hawthorne Blvd, Hawthorne, Calif.**



Relays . . .

. . . general purpose, front-connected, are used as fault detectors to supervise main protective relays, also as protection of motors to prevent damage from high current or low voltage under abnormal conditions where time-delay relays would not operate fast enough. Types SC and SC-1 relays can be used on dc and 25 to 60-cycle ac without coil

(*Continued on page* 80)

Widely used on

- Insulator pins
- Crossarm bolts and braces
- Clevises and clamps, etc.

- **Eliminates checking and re-tightening**
- **Eliminate radio interference due to loose hardware**

Every bolt - and - nut assembly locked with PALNUT Lock Nuts stays tight, despite weather, wind, stress and vibration. PALNUTS, tightened on top of the regular nuts, prevent loosening and falling off. Very low in cost—easily, speedily applied — require little space — may be used on new or existing assemblies. Hot dip galvanized, silicon bronze and other materials and finishes. Stocked by all leading pole line hardware manufacturers.

The PALNUT Co.
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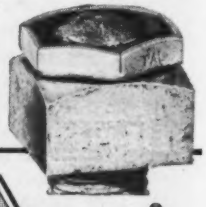
51 Glen Road
Mountainside
N. J.



PALNUT®
LOCK NUTS

ALLIS-CHALMERS

Extended Foil Capacitors

A-1473

4800-kvar Allis-Chalmers capacitor enclosure with provision for future expansion to 6000 kvar.

Install an Allis-Chalmers CAPACITOR ENCLOSURE where

appearance and dependability count

Allis-Chalmers enclosures are complete:

- Shipped assembled with 50 kvar capacitors, fuses, controls, current and potential transformers, switch and incoming line termination.
- Capacitors individually fused.
- Fans in each modular section thermostatically controlled.
- Mechanical interlocks insure a closed grounding and shorting switch before cubicle doors can be opened.
- Dead-front control compartment isolates the circuit breaker and grounding switch.
- Vacuum switch or circuit breakers can be supplied.
- Roof entrance bushings or pothead for underground cable is available.
- Viewing window in rear of entrance cubicle for visual check of grounding switch position.
- Outdoor metal enclosure with three coats of paint.

Specify **Allis-Chalmers** *extended foil capacitors! Call, wire or write your nearby A-C office.*

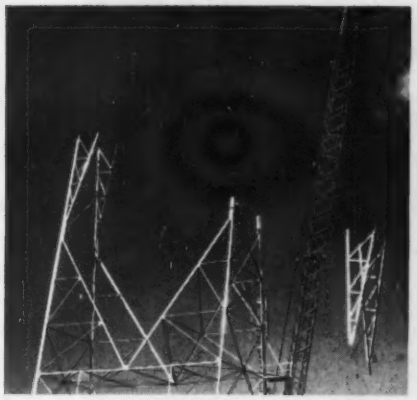
Capacitor enclosed equipment available for 2400 through 13,800-volt, three-phase service, up to 6000 kvar. Allis-Chalmers also offers outdoor stack-racks and pole-mounted racks as well as current and voltage sensitive controls.

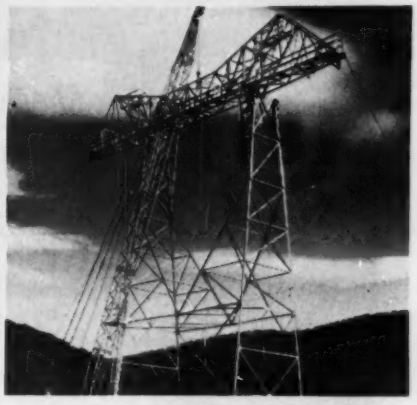
Allis-Chalmers extended foil design capacitors withstand higher inrush currents. Current densities are lower at point of contact between the packs and the contact plates than is possible with conventional tab-type capacitor construction.

HILLER 12E
N53

From Crossarms to Complete Towers...

Alcoa® Aluminum. Dropped from the air or built straight up. ■ Designed and fabricated by Alcoa Structural Division for economy — speed — strength.





Write:
Aluminum Company of America
Structural Division
871-L Alcoa Building
Pittsburgh 19,
Pennsylvania

ALCOA ALUMINUM

STRUCTURAL DIVISION

Entertainment at its Best . . . ALCOA PREMIERE
with Fred Astaire as Host . . . Tuesday Evenings, ABC-TV

STEEL STRAND

Checked and Double-Checked by Laboratory Technicians

Every coil of wire used in the manufacture of *Crapo* Galvanized Steel Strand is tested and approved by trained laboratory technicians. Samples from both ends of each individual coil are subjected to a series of prescribed tests before stranding. Then, the finished strand is re-checked to make certain that it conforms in every respect to established specifications and our own high quality standards.

Thus you know when you specify *Crapo* Galvanized Strand that every precaution has been taken to assure maximum performance in the finished product.

Write for Free Booklet

"The Story Behind Crapo Galvanized Wire and Strand" illustrating and describing manufacturing techniques and testing procedures. Ask for Booklet B-59!

AVAILABLE IN 3 COATING WEIGHTS

FOR GUYS, MESSENGER AND OVERHEAD-GROUND WIRE

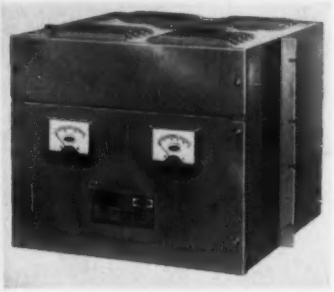
Crapo Steel Strand is available in all standard sizes and grades and in Class A, B and C galvanized coatings. Class B coating is twice as heavy as Class A coating; Class C coating is three times as heavy.

*Determines ductility of wire and adherent quality of galvanizing.

INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana

changeover, and are available for either dc, or 50 or 60-cycle ac service. Design of the units features a new base which makes terminals and connections to contacts and coil available from the front. They are flat mounted. Operating elements of the relays are of the instantaneous plunger type to provide one-cycle operation at two times pickup on ac. Pickup is adjustable over the entire range of the relays and can be set for specific values of either pickup or dropout.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



Power Supply Units . . .

. . . features silicon power rectifiers to reduce cabinet size by as much as 50%. The S-Series power supplies, 24 and 50 v, include battery chargers, battery eliminators and end-cell chargers. They employ a simplified and standardized ferro-resonant design which is said to eliminate extraneous semiconductor control circuitry. Power supplies provide stable and filtered dc, regulated to within ±1% of rated value with loads from 0 to 100% and ac line variations from 95 to 130 v. They feature complete overload and short-circuit protection. Unit shown is 50-v, 12-amp, single-phase battery charger which is only 15 in. high.

Raytheon Co, Richards Ave, South Norwalk, Conn.

Connector Compound . . .

. . . protects electrical connectors from erosion, dirt and chemical attack—also is said to extend in-

PENGO AUGERS

Save you money 4 ways

PENGO HEAVY-DUTY Twin Helix Augers—14" through 96" hole diam.

1 **BORE FASTER**...put real "teeth" in earth drilling, save wear and tear on your diggers.

2 **STAY ON THE JOB LONGER** ...all wearing parts replaceable in the field; no down-time for shop welding.

3 **COST FAR LESS TO MAINTAIN** ...reversible teeth cost only 90¢ each, pilot bit only $8.00. Parts interchangeable on all PENGO augers you are using...less inventory!

4 **A SIZE AND TYPE FOR EVERY BORING JOB**...Augers and boring heads (for welding to your present auger) available for every make of machine from post hole diggers to largest heavy-duty earth drills. Write for catalog.

PENGO Prope®

—the most satisfactory construction rope available today!

* GREAT STRENGTH (8,200 lbs. for ¾" diameter)
* LIGHT WEIGHT (11 lbs. per 100 ft. ¾" diameter)
* HANDLES AND SPLICES LIKE MANILA in any climate or weather
* WATERPROOF (even salt water); can't mildew or rot. Excellent dielectric properties.

PENGO-Prope is a synthetic rope of special construction available in all popular diameters from ¼" to 2"; regular construction in sizes smaller than ¼". Write for specifications, prices.

PETERSEN
ENGINEERING COMPANY, INC.
Santa Clara, California
Axminster 6-7712

hibitor life. Mylar-backed mastic compound does not become brittle or flow within a temperature range of —50F to 250F. During installation, it safeguards the connection against puncture. It provides electrical insulation level of 1 kv per mil.

A. B. Chance Co, Centralia, Mo.

Outdoor Padlock . . .

. . . does not freeze or rust under the most severe weather conditions, says manufacturer, backing statement with guarantee. "No freezing" is the report of maintenance men who have had to unlock these padlocks at substations to get at circuit breakers after an ice storm. Face of the lock is protected by a flush-fitting, flip-up lid held snugly against the padlock by a stainless-steel flat spring.

CLM Industries, McGraw-Edison (Canada) Ltd, Toronto 13, Can.

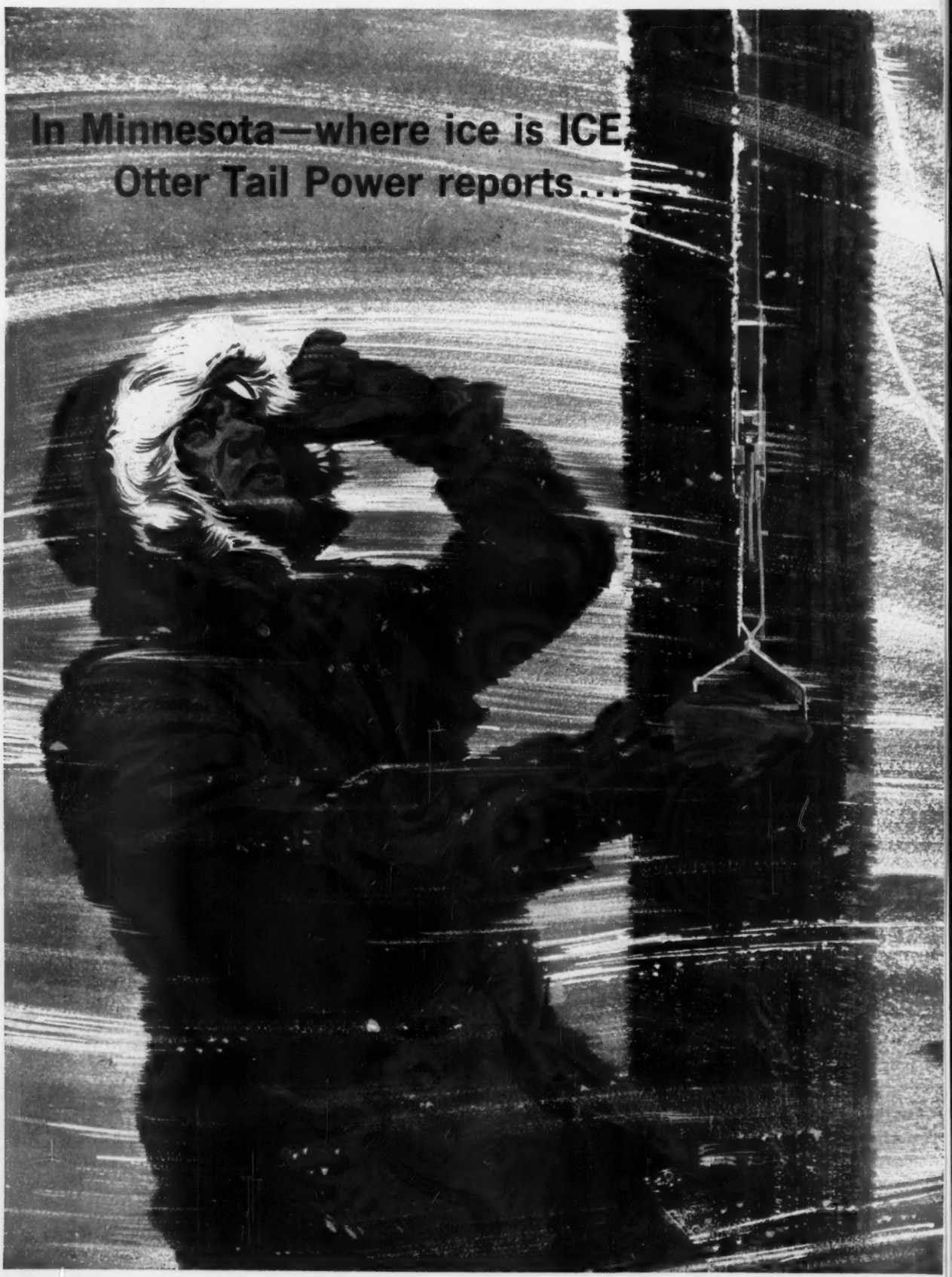
Searching for Test Facilities?

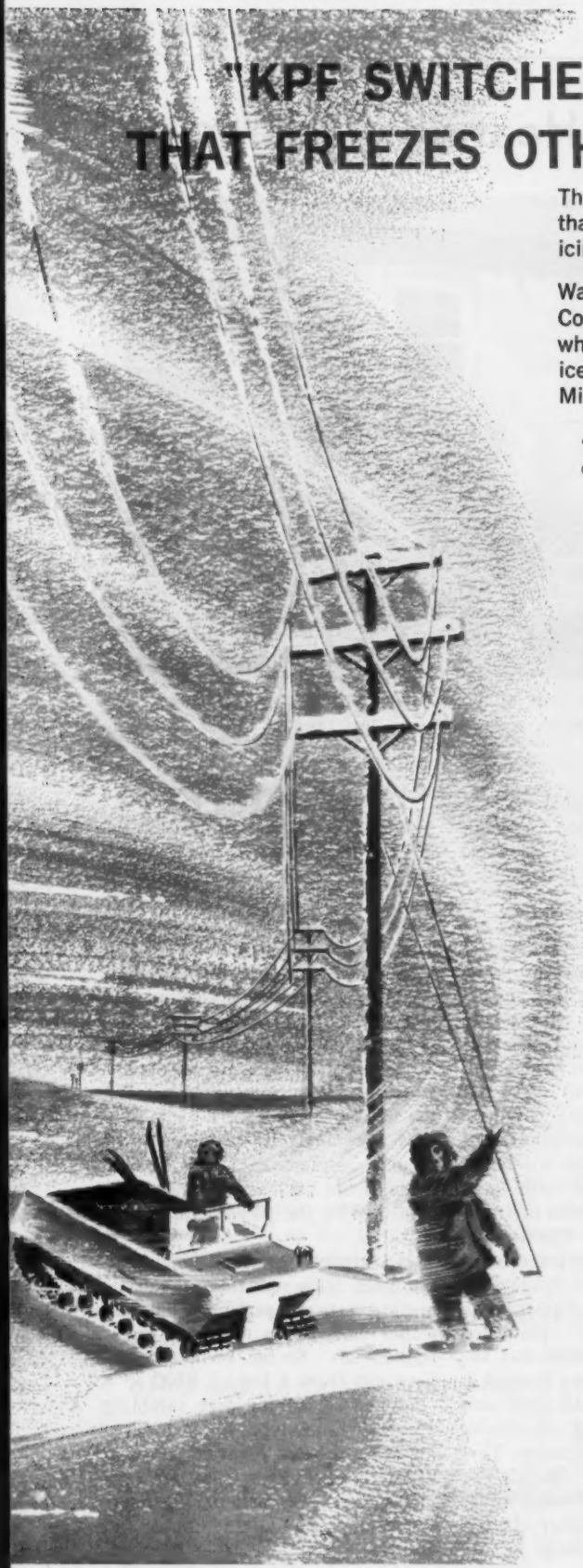
look to...

SUPERIOR
SWITCHBOARD & DEVICES CO.
CANTON 1, OHIO
A Subsidiary of
The Union Metal Manufacturing Co.

Test Switch

Write for a free Catalog outlining types and sizes of test switches, test blocks, reactiformers, enclosures and meter socket equipment.


In Minnesota—where ice is ICE,
Otter Tail Power reports...



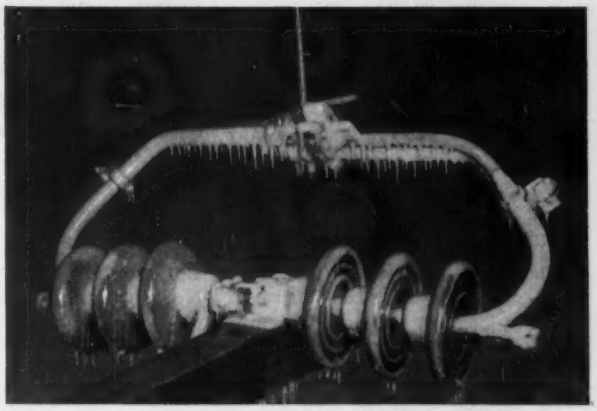
"KPF SWITCHES OPERATE UNDER ICE THAT FREEZES OTHER SWITCHES SOLID!"

The hard clear ice of northwestern winters — and the silver thaws of Texas — probably provide utility men with as much icing trouble as any set of conditions in the United States.

Warren Nye, Vice President, Electrical, of Otter Tail Power Company, has had his share of 80 mile per hour winter winds, whipping iced lines, and poles and switches sheathed in pure ice. Writing from his Company's headquarters at Fergus Falls, Minnesota, Mr. Nye says succinctly,

"We have found KPF switches easier to operate under conditions of ice than any other switch we have ever used."

HOW KPF SWITCHES CRACK OFF ICE



The mechanism of KPF switches is big, simple and rugged. There are no complex, finnicky doodads to freeze, bind or need lubrication.

A simple, positive-action control rod moves an interphase rod which rotates the blade arms of KPF phase units.

Blades and stationary clip holders are flexible so the moving arms can, literally, be "rocked" or "wobbled" by one man at the operating lever below.

The force exerted at the switchblade-clip holder position is many times that required to crack off the thickest natural ice.

The only time KPF switches have been not immediately operable under ice was when the entire pole and control rod assembly itself was sheathed in ice. It was necessary to clear ice to reach the operating lever and effect the "cracking off" process.

Install a KPF unit in your most demanding location - and watch its dependable, easy operation

KPF ELECTRIC CO.
P.O. Box 1257E
Stockton, California
HOward 4-8381 • Area Code 209

KPF
AIR BREAK SWITCHES
Standard for half a century

Sells Older Homes With Heating 'Package'

A successful method of tapping the older home market for electric space heating is the "package" or "turnkey" plan embracing the heating units, insulation, wiring and financing. Under this plan the Anderson-Young Electric Co, an electrical distributor in Lubbock, Texas, has provided complete electric heating installations for about 50 homes in west Texas since Nov., 1960.

This turnkey plan results in:

1. Satisfied electric space heating customers for the electric utility through a complete installation, coordinated, designed and installed by one contractor.

2. An increase in business for the electrical distributor, particularly during the normally slow winter months.

The Anderson-Young firm, long a distributor of line hardware and other utility equipment, became an appliance distributor only in later years. Since the war it has taken on first evaporative coolers, then refrigerated air conditioning units. With the acceptance of the heat pump in their area, the firm got its start in electric heating with window units.

To smooth out the winter-time valleys in business activity, the distributor investigated the possibilities of installing electric heating in older homes in rural areas of west Texas patterened on a turnkey approach. Anderson-Young found that a homeowner in a rural area or small town who wanted electric heat faced several major problems. The engineering for the electric heat installation was, more often than not, lacking. Insulation installers were reluctant to do jobs too far from their big city bases. In the smaller towns there were no insulation installers.

Also, assuming that all necessary services and supplies were available, the homeowner found himself having to sub-contract engineering service, insulation service, carpentry, electrical work, equipment, storm windows and doors, and possibly masonry and painting services. None of these carried the assurance of a quality job or of a reasonable operating cost.

INSULATION packing is part of the complete heating package offered by Anderson-Young; stepped-up winter business has resulted under new plan

Insulation Machine Purchased

In getting started, Anderson-Young purchased an insulation blowing machine that packs insulation between studs in new or old houses, and arranged for the purchase of cellulose fiber insulation, storm windows and all necessary items needed to do the complete job. The only service sub-contracted is the electrical work; this is done on a local basis. Coupled with these arrangements was a series of training meetings in which Electriliving of Wichita, Inc, a Kansas electric heating contractor, and Southwestern Public Service Co cooperated.

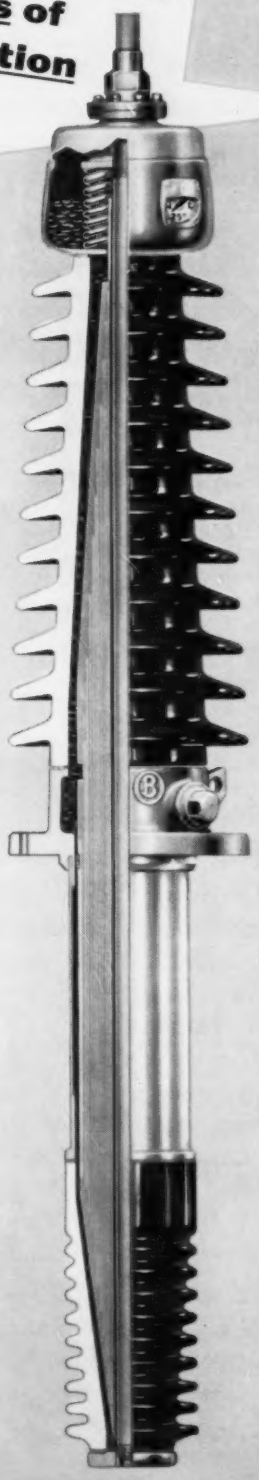
The new "package" plan for electric heating installation was announced by Southwestern through a concentrated direct mail approach to rural customers and advertising in a regional farm publication. This kind of cooperation normally is given to any qualified company that might go into the complete electric heating installation business.

As Anderson-Young gained experience, it began to interest its dealers in the activity. Currently, there are eight dealers doing the complete electric heating jobs with varied assistance from the distributor. Jobs usually are completed in one or two days. They are arranged so that the homeowner continues to use existing heating equipment until the new installation is completed. Thus no inconvenience is experienced by the customer. At present, the 60,000-sq-mile territory is covered adequately by two Anderson-Young salesmen. They develop most of the business through leads furnished by the power suppliers in the area.

Homeowners are experiencing an estimated 50% reduction in electric heating costs compared to what they would have been with a "jerry-rigged" job. So far, complete jobs have run from a low of $500 to a "high" of $4,500 for large, rambling $50,000 ranch-type homes. Most jobs have been financed through FHA loans. Financing arrangements also are handled by Anderson-Young should the buyer so desire.

Why buy O-B bushings?

Heavy cast bronze oil reservoir, insulated compression springs, duplex gaskets – among nine points of O-B distinction



When you buy O-B bushings, you get qualities that add up to a superior bushing:

1. **Heavy cast bronze reservoir** - - Rugged casting helps bushing survive accidental power arc.
2. **Insulated compression springs** - - Insulating tube prevents spring annealment under high currents.
3. **Duplex gaskets** - - Concentric gaskets provide hermetic seals and sure-footing for metal-to-porcelain joints.
4. **Continuous loading of gaskets** - - Long coil springs sustain uniform loading on seals throughout temperature changes and bumps.
5. **Rigid cores** - - O-B condenser core's extra strength is imparted to housing and flange - - particularly important for circuit breakers.
6. **Interchangeable terminals** - - For each voltage class, O-B makes a common bushing interchangeable from O.C.B. duty to transformer draw-lead through simple change of terminals.
7. **Free oil passages** - - Entire length of the bushing contains oil. Oil passages allow free flow from top to bottom.
8. **ASA Standards** - - O-B bushings not only meet Standards but permit standardization to the point of one bushing and an extra terminal per voltage class!
9. **Testing** - - All O-B bushings are subjected to one of the most extensive testing programs in the industry.

If you would like these qualities included in your next bushings, specify O-B.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10108-H

OHIO BRASS MANAGEMENT REPORT

UNITED WAY OF GIVING, PLANNING HELPS US TO SERVE TWO MASTERS

BY GEORGE L. DRAFFAN
CHAIRMAN, OHIO BRASS COMPANY

Your community's 1962 United Appeal or United Fund drive, like those in O-B plant communities, has probably just been completed. Our management strongly prefers the united or federated approach to health, welfare and recreation problems, both in collecting funds and in planning for their expenditure.

IN THE OHIO BRASS HEADQUARTERS community of Mansfield, a United Appeal drive collects for 30 volunteer health and welfare agencies. But even more important than the combined effort in collecting funds is the combined planning on how they are spent. United Community Service works year-round to help coordinate the activities of the United Appeal agencies plus those of several tax-supported agencies. United Community Service is a planning organization. It tries to prevent duplication of services and to get first consideration for the most serious problems.

IN OUR COUNTY, WE SPEND annually $7,670,000 (about $65 per capita) for health, welfare and recreation services for a population of 117,000. 47 per cent of the total comes from tax dollars, 46 per cent from fees for services, and 7 per cent from contributions. Approximately one-fourth of the tax dollars comes from the federal government, the rest through state and local taxes.

COMPARED TO EXPENSES in big metropolitan areas, our total seems small. But it's big to us. And we don't want it to get bigger than necessary. Yet we want the expenditure to be effective. That's why over-all planning and direction are important.

WITH HOME TOWN PEOPLE running United Community Service, we retain some independence from state and federal control. Not complete independence, of course, in this day of matching funds. But basic direction of the program belongs to local people, many of whom work at Ohio Brass.

WE ENCOURAGE O-B EMPLOYEES to participate in United Community Service for several reasons. First, they have the talent and desire to give competent direction to the program. Second, it gives them recognition in the community. And like all wholesome outside interests, it often provides stimulation which makes them more creative on the job.

AS A CUSTOMER OR POTENTIAL CUSTOMER, you have a direct interest in how we spend our time. I hope this report indicates to you that we are doing our jobs as citizens, both individually and as a corporation, and doing it in a way that enhances our ability to serve you.

HOLAN

10154-H

OHIO BRASS COMPANY, MANSFIELD, OHIO

Porcelain Insulators – Line Hardware – Capacitors – Lightning Arresters Bushings – Holan Truck-Mounted Power Devices and Bodies – Bronze Valves

Electrical World

NOVEMBER 13, 1961

Management Newsletter

Shell Homes Are a Growing Market

Shell housing is the star performer of the home-building industry. Contrasted with the mediocre performance of the housing industry in general, the segment which produces shells is enjoying quite a boom. Conservative estimates put the number sold this year at about 100,000 units, double the number sold only two years ago.

The percentage of shells in the total housing market is now in the vicinity of 8%. And from all indications, the shell will take an even larger percentage next year. This means that it's becoming a significant section of the housing market—too significant to be ignored by a utility trying to build a home-heating load.

But the basic shell house is a poor market for electric heat. It sells anywhere from $1,800 to $3,500, and has its biggest appeal to the rural family with an income between $3,000 and $5,000 a year. Families in this bracket are looking for the cheapest kind of home they can buy. The comfort and convenience of electric heat wouldn't impress them as much as a few dollars difference that might be involved in installing an electric heating system, or a few cents a month increase in heating expense.

What's a shell house? Strictly speaking, it's the outside walls of a house with the floor and roof. In its purest form, the inside is unfinished except for partition studding and ceiling joists. The customer has the shell built on his own land and then goes to work making the inside livable. If all the growth in shell housing

were in this basic low-cost form, utilities would probably have to write off the shells as potential customers for electric heat. But, the original shell concept has lost some of its purity.

With more and more firms entering the field, the simple empty shell has grown up. In the bid for the customers' money, some firms began to include plans for completing the interior. Others struck back by not only offering plans, but by throwing into the package all the equipment necessary to finish the interior. And still others did some of the inside work themselves prior to the sale. As a result of these competitive forces, shells today can be bought in almost any shape or degree of completion. And the prices run as high as $10,000.

The market for the shell has expanded right along with the price. Builders no longer limit themselves to low income customers. Instead, they offer some models that are designed as second homes for the family that already has suitable housing. They aim at the do-it-yourself market—the man who wants to design and build his own interior more for the relaxation of working with his hands than as a result of financial necessity. And, they have appeal to the young family anxious to customize their home, but unable to stand the expense of building up from the foundation.

Today, shell housing covers a broad range of products and production methods. Some builders still offer only the basic shell and still aim at the low income customer. Others offer the basic shell, the shell with walls, plumbing, and heating already installed, or the house completed with the exception of wood work and painting. Each stage of completion comes at a different price.

Electric heat may have been shut out of the original low-cost shell concept, but it is by no means eliminated from some of the more complete and more costly ones. And with the realization that the shell is the faster growing sector of the housing industry, it becomes important that utilities study the economics of shell housing in their territories and make an effort to capture for electric heat the largest possible portion.

At first look, it might seem that some of the characteristics of shell home construction make it a very difficult market. Shells, for example, are seldom constructed in multi-unit developments. When several homes are built in one project, the utility can talk directly to the builder. And, if it is successful in selling the builder on electric heat, it gains all the houses in the development as customers. But when housing units are built separately, on scattered plots, it might appear that the utility has to sell each individual customer. Tackling such a task would call for tremendous expansion of its selling efforts.

But actually, there's no need for the utility to talk to every shell buyer. There are many cases where the utility wouldn't even have to convince the builder. What it has to do is to get its story across to the key men in the shell housing industry.

Two types of builders dominate the shell housing field. First is the local company which purchases house plans, buys the necessary materials on the open market, and sets up its models along a highway. This firm is in business for itself, and shell sales, plus the money it can make on financing the sales of its homes, are its only sources of revenue. Such a builder may sell his homes in any degree of completion. Usually, what he doesn't install himself he will supply to the buyer. Or, at least, he will give the buyer the specifications of the equipment needed, and will recommend to the buyer a dealer who can supply the material.

In any case, either the material he supplies, or the material he recommends, will greatly influence the action of the buyer. If, for example, the builder insulates for electric heat and recommends electric heat, there's a good chance that the buyer will install electric heat. Here, then, the utility need know nothing of the

buyer. It doesn't even have to know when or where shells are being constructed. If it can get its message across to the builder, chances are it will win customers.

But frequently, the actual builder is merely a representative of a large building materials manufacturer. Several building materials concerns have drawn up plans for shell homes utilizing their products. They give the plans to their dealers and set the dealer up in the shell home business. The dealer shows the plans to prospective buyers and advertises the features which the plans contain. When he makes the sale, he constructs the home according to specifications, using the materials provided by the building materials manufacturer.

When this pattern is used, it does the utility little good to talk to the individual builder. He's merely an agent. Here the utility would have to sell its ideas to the building materials company itself. It would have to work with the company's plans, point out the advantages of additional electrical installations, and submit suggested designs.

Of course, these are only two of the possible patterns. Undoubtedly there are many variations. And from all indications, the variety of methods is going to increase. New companies are entering the field and may well bring with them new marketing approaches. Aluminum companies, for example, feel they have a natural material for shell construction and are rumored to be looking seriously into the field. The same thing holds true for aircraft manufacturers who may see the shell as a profitable new line in their diversification programs.

But in any case, the approach of the utility should be the same. It must learn who is providing the plans, and who is recommending the installations to the customers. This is the person that the utility must approach and sell on the advantages of electric heat.

Why would builders recommend electric heat, and put it into their plans? For one thing, those offering the electric heat would have a competitive advantage over builders who did not. Shell home manufacturers can win sales only by what they are able to put into the house. Landscaping can't be a sales advantage because the buyer has his own plot. Nor can the builder expect to benefit by the location of the home—its nearness to schools or to transportation facilities. Again, the buyer owns the lot and can't do anything about the location.

If the shell home builder is to offer something extra he will have to put that extra into the house. By offering electric heat and other facilities he gains a real advantage. And he has the entire Live Better Electrically program helping him to close the deal.

There are other advantages of electric heat that might prove particularly appealing to the prospective shell home owner, and therefore, to the shell-home builder. First, shells are typically small homes with no basements. This means that a central heating plant has to take up room in the living space of the house. Electric heat needs no central unit. Another item which might appeal to the do-it-yourself customer is the comparative ease of electric installation. He has to connect to only one utility, and there's no need to sink a fuel tank somewhere on the property.

The buyer may also be planning on expanding his home as the need arises. With conventional heating installations, he may need a larger central unit before he'll be able to expand. With electric heat, he can add as he sees fit.

These are some of the advantages that the shell home buyer might find attractive. And many builders would probably be glad to offer them. One builder told *Electrical World* that he recommended the type of heating he did because it was easy for the purchaser to install. For the same reason, he might well be persuaded to recommend electric heat.

How about cost? Despite the advantages of electric heat, is it, nevertheless, too expensive for the typical shell buyer? For the very low income buyer who wants only the least expensive shell with the minimum of frills, adequate electric heat would certainly be beyond this means. But so would any other kind of adequate heating. The point is that there is a definite section of the shell market that wants a good home and a good heating installation. And for this section, electric heat has a story to tell.

In the competitive reference manual, prepared by the Southeastern Electrical Exchange, the costs of various heating systems are analyzed. Generally speaking, the costs of electric heat and flame heating are competitive. In some areas of the country, electric heat is even cheaper. But even in the areas where it is slightly more expensive, it may still be competitive in view of the advantages it offers, particularly to the shell buyer who has the minimum of space to work with, and may well be doing the installation himself.

Besides, shell home buyers will be able to spend more money now than they have been in the past. This is because of the change in financing arrangements. In the past, shell homes have been unable to qualify for standard mortgages or FHA mortgages, because the bare unfinished shell does not provide adequate security to the lender. As a result, the shell has been financed in much the same manner as automobiles, or big ticket appliances are financed. Payments ran from five to seven years, and the effective interest rates have been in the vicinity of 12 to 15% and even higher.

But today's shells are more elaborate, and an increasing number are eligible for mortgage terms, running out to 30 years. Under these conditions, the same monthly payment buys more house. And it may well provide for many of the extras beyond bare shelter—including electric heat.

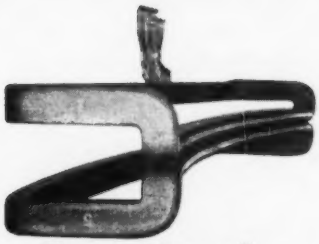
Still, despite the trend toward more elaborate shells, the price of this type of housing is low and not really competitive with the kind of housing built during the 1959 housing boom. It is aimed primarily at the lower priced market. And for several years to come, this may be the market that sees the most activity. The noted housing economist, Dr. Robinson Newcomb, in an address before a conference at the National Housing Center, had this to say:

"Home builders and trade publications alike have been complaining about the sluggishness of the housing market. Maybe the problem is not so much a slow market as it is a failure to build for the market that does exist. The automobile industry discovered its market had changed after it lost sales to foreign manufacturers who did recognize the market for smaller, compact cars . . . A similar story is evolving in housing. The market is changing."

Newcomb goes on to describe the inroads being made by apartment housing, prefabricated housing, and government housing—all aimed at the low cost market. He adds to these developments shell housing and estimates that added together, the low cost market now accounts for about 40% of the new housing put in place. Clearly, the utilities can't wave off such a large segment of potential residential customers. They must, at least, try to tell their story.

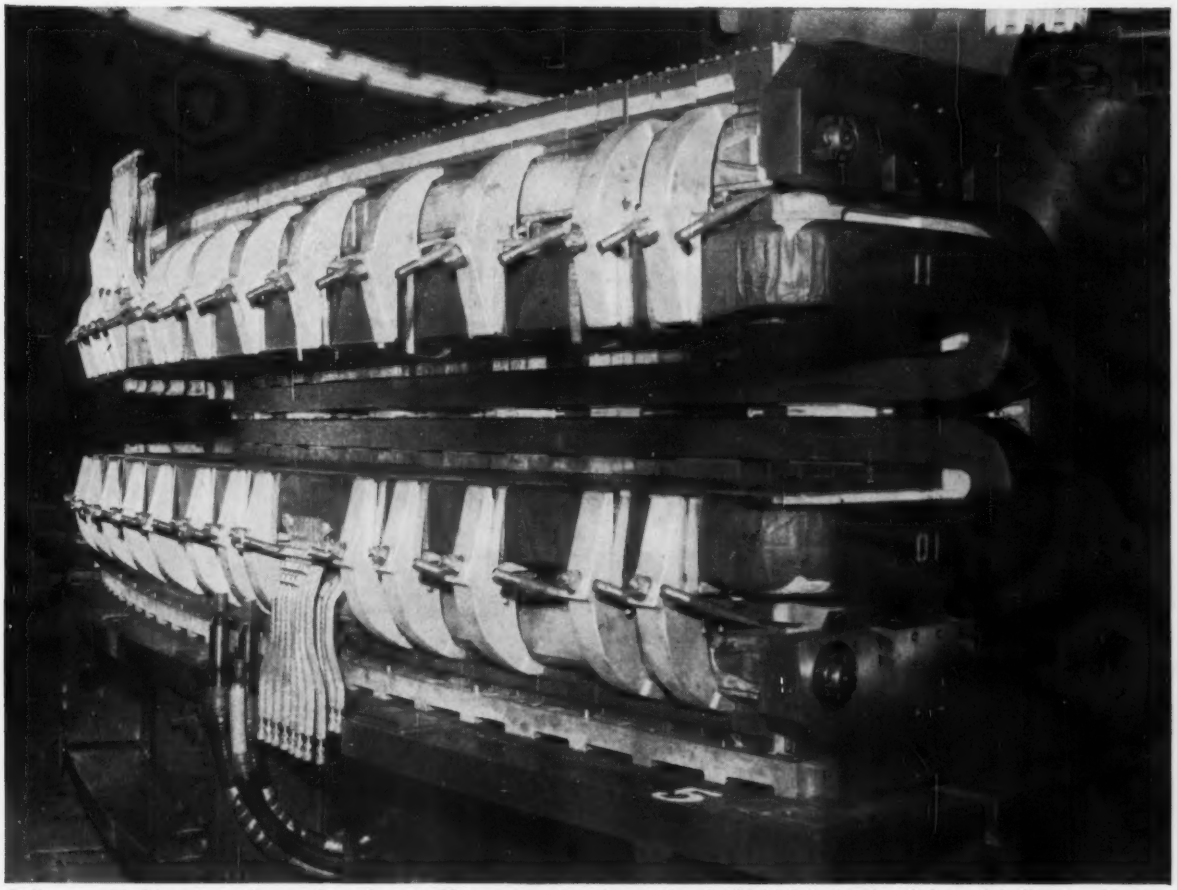
And there might be some encouragement in Dr. Newcomb's example of the compact car. The public has certainly turned favorably to the compact. But they haven't stuck to bare necessities. Today many of the compacts feature extras—automatic transmission, radios, leather interiors, white wall tires and other items usually found in larger models.

There's also a trend to the compact home. Here again, the public seems to want more than the bare minimum. Perhaps utilities can sell their product as one of its extras.



Upper and lower coils before installation.

National builds unique magnet coils for 3-billion electron volt accelerator



Coils assembled in magnet frame of accelerator. Note connections for cooling fluid which is circulated through hollow conductors.

For the new Princeton-Pennsylvania Accelerator, National manufactured, inspected, tested and delivered 40 finished magnet coils.

Some of the unique design features—which required special tooling and a new insulation system—were:

Extremely complicated coil configuration. Each coil was 12 ft. long, 2 ft. wide, and weighed 800 lb. Each coil was wound in eight individual layers, consisting of four turns of ½" square hollow copper conductor. No conductor splices were permitted internally in the coil. Each layer was wound with continuous conductor lengths of 92 ft. to 124 ft.

Rigid monolithic insulation system—required by the high pulse rate producing fatiguing mechanical forces. Turn-to-turn bonding strength is greater than 500 psi, and shear strength greater than 1000 psi.

Resistance to intense nuclear radiation—in the order of one million rads per hour.

National's experience in design and production of coils vacuum impregnated in Epoxy resins met the exacting requirements here, as on many other leading nuclear research apparatus projects. For help on your special coil requirements, call our Columbus plant... HUdson 8-1151 ... or the nearest National field engineer.

DIVISION OF

National Electric Coil

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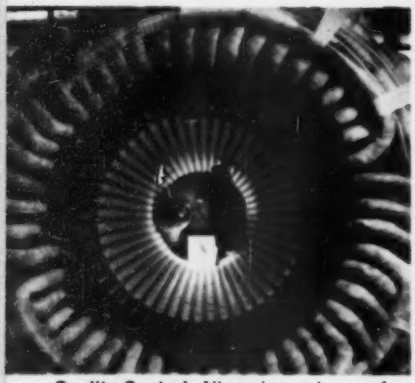
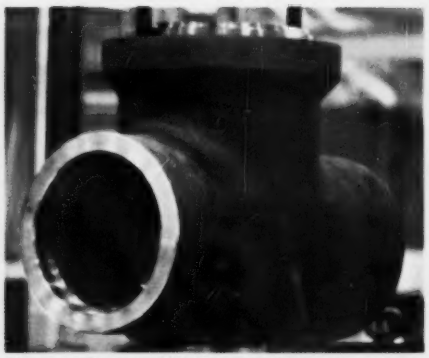
McGRAW EDISON

Westinghouse supplies all these vital mechanical components for nuclear reactor plants

Canned Motor Pumps. This skilled technician is machining a canned motor pump shell and flange on a modern 100" vertical boring mill. Pump is an important nuclear reactor component.



Quality Control. All equipment manufactured by the Atomic Equipment Department is subjected to maximum quality controls. Stringent hydraulic, electric and mechanical inspections result in essentially maintenance-free performance.

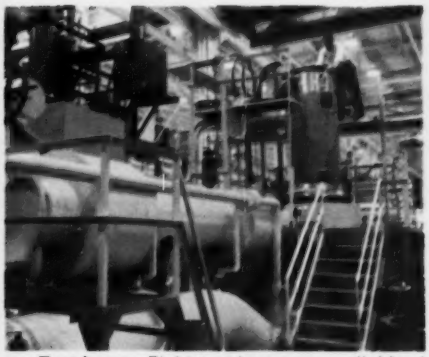


Nuclear Reactor Valves. This 20" motor operated gate valve has been machined and is ready for testing before shipment for SELNI in Italy. Valve is one of many Westinghouse designs for reactor plant primary systems.

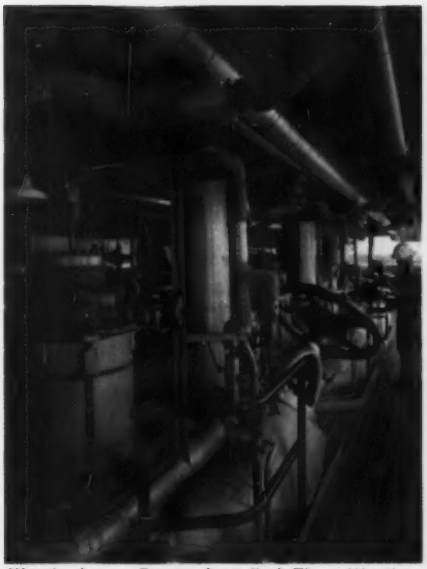
Modern Production Facilities. Advanced production and testing equipment in modern plant at Cheswick, Pa., make Westinghouse Atomic Equipment Department the most complete facility of its type in the world.

Control Rod Mechanisms. Inspector is working on a control rod mechanism to be installed in new Saxton, Pa., reactor. Moving parts of mechanism are hermetically sealed.

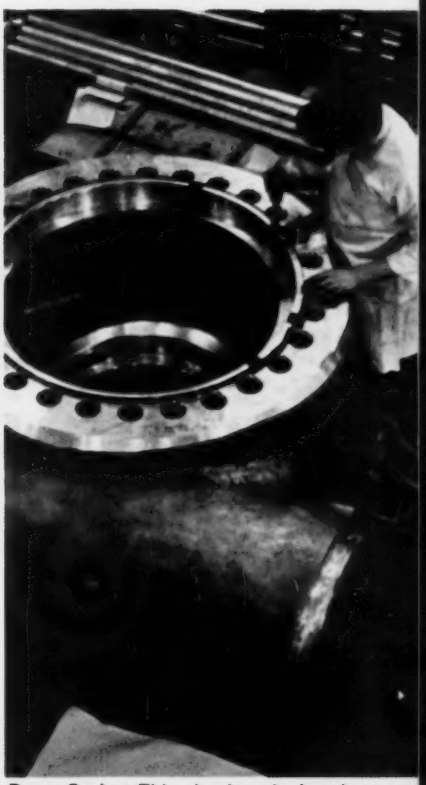
...and canned pumps for controlled circulation boilers



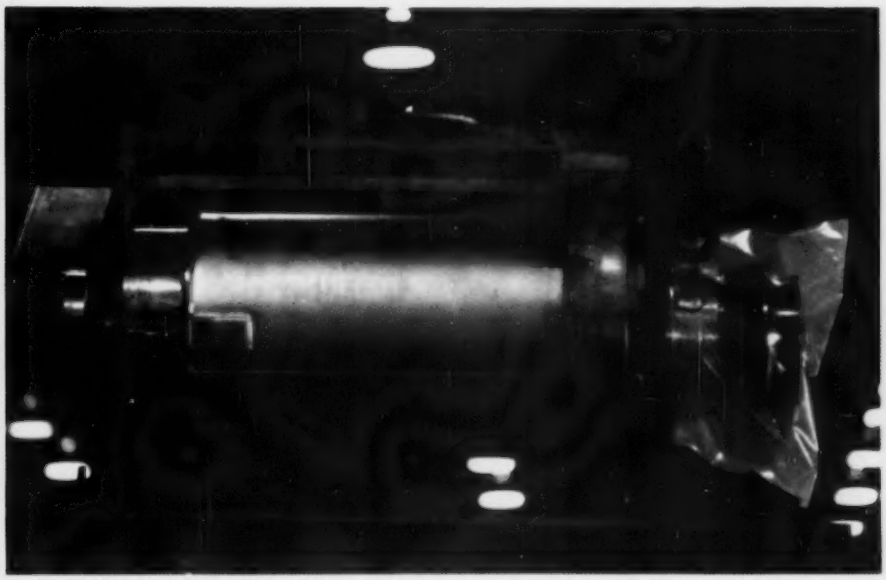
Test Loops. Eight test loops are available at the Atomic Equipment Department for rigid testing of all products. Loops can be adapted to handle flows from 1 to 40,000 g.p.m.



Westinghouse Pumps Installed. Three Westinghouse canned motor pumps are shown installed in power plant in Hartsville, South Carolina. Motor and pump casing completely enclose the pump shaft, eliminating the problems of the seal-injection system.



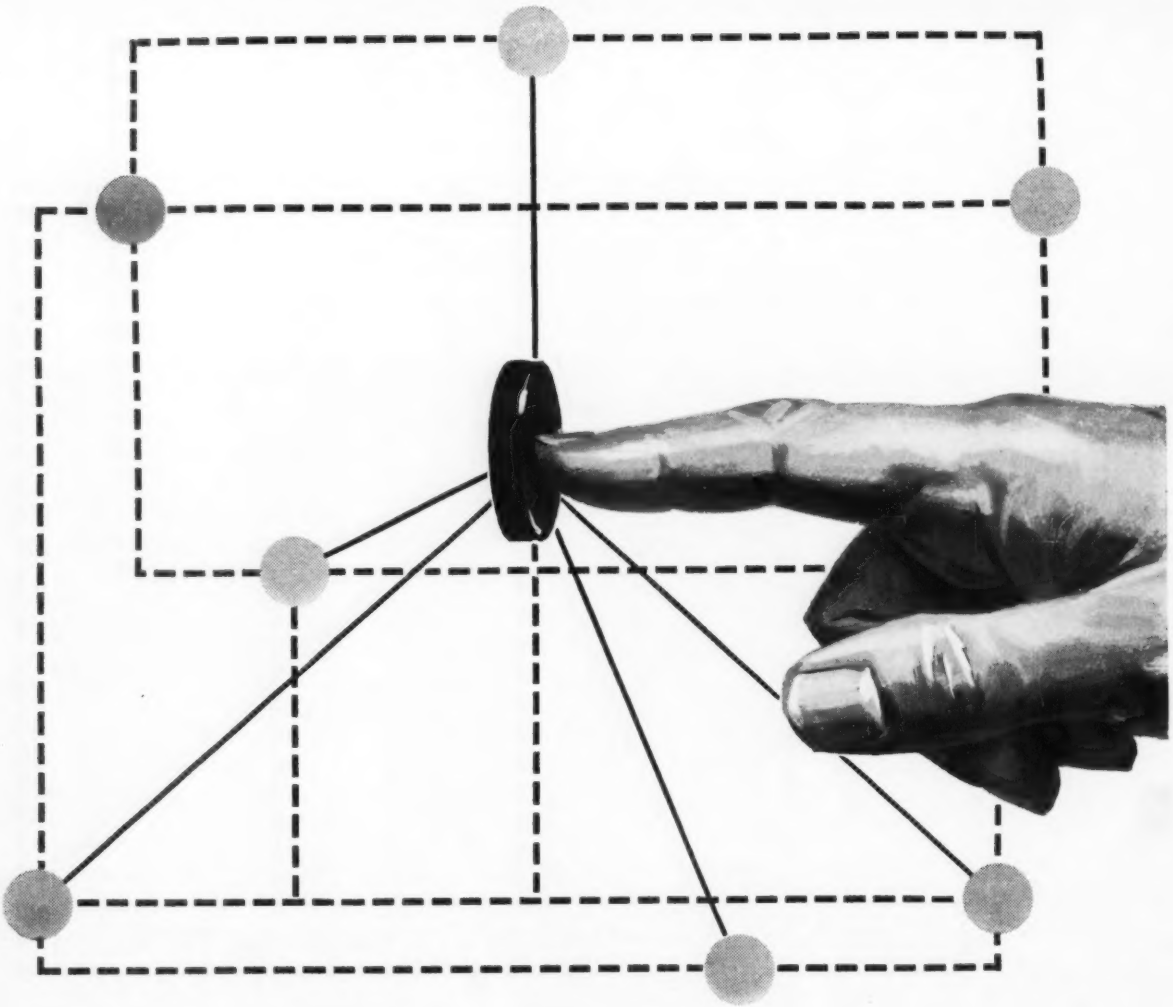
Pump Casing. This nine-ton steel casing will be installed with a canned motor pump in a nuclear reactor plant. Casing and pump form a leakproof unit.



Controlled Circulation Boiler Pumps. Westinghouse manufactures canned motor pumps such as this for service with Combustion Engineering controlled circulation boilers. Standardized pumps are available in many head and flow combinations for these high temperature, high pressure boilers.

J1-58005

Westinghouse



Announcing ATRC cable for interconnecting telemetering, relay, communication and control systems utilizing up to 300 volts

ATRC is Anaconda's answer to the need for a cable which facilitates centralized control of systems—including those using standard telephone cables. ATRC cables contain twisted pairs, fully color coded according to standard Industry requirements for telephone cables. Bright, permanently colored insulation and unit binders readily permit pair identification. ATRC cable is available in No. 16, 18, 19 and 22 Awg., with from 3 to 200 pairs in all conductor sizes, for aerial and duct installations. Special double-jacketed sheath is available for direct burial.

ATRC construction assures long service life because:

1. All insulating material is virgin high-molecular-weight polyethylene which resists moisture, provides excellent transmission characteristics.

2. Jackets are made of virgin high-molecular-weight polyethylene which resists abrasion, chemicals and moisture and provides long life under extreme weather conditions.

3. Conductor insulation meets IPCEA requirements for 300-volt rating. Jackets meet REA requirements. Complete assembly is dry-tested conductor-to-conductor and conductor-to-shield, using the shield as ground.

4. All insulated conductors, after twinning, are water tested (immersed for one hour, energized for five minutes) prior to cable assembly.

5. Cable core is completely covered with a layer of non-hygroscopic dielectric material.

6. All shielding tapes are applied longitudinally with positive overlap, and corrugated for extra flexibility.

7. On direct-burial types, all inner jackets are pressure tested for possible ruptures or other defects.

For more detailed information on ATRC's advantages in control or communication circuit centralization, contact Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York, Department EFL-1-EW.

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ASK THE MAN FROM

ANACONDA®

FOR TYPE ATRC COMMUNICATIONS CONTROL CABLE

PEA Prime Movers Meet (*Continued from page 53*)

Davidson said, "to develop Plans A, B, C, and X as alternatives to accomplish the same end, and determine and compare the revenue required from the customers for each of the several plans."

The "revenue requirements" concept, he explained, stems from the fact that each capital investment brings a series of annual expenses for taxes, depreciation, insurance, operation, and maintenance. An adequate return, as interest on the investment, is also required, so that the utility can continue to serve the next year's load. Annual expenses must also be obtained from the only source of revenue—the customers.

Requirements Defined

"The term 'revenue requirements,' with its customer-oriented connotation, is accepted widely by utilities, whose only uncertainties arise from the value to be used as an adequate return," Davidson said. "For practical purposes this value falls in a narrow band between the minimum rate necessary to attract capital and the maximum rate permitted by the regulatory bodies, 6 or 7% being typical.

"Economic comparison begins with a step-by-step development of plans for capital additions over a period of years. Alternatives may embrace small units or elements installed frequently, large units at longer intervals, or combinations of large and small elements, all winding up at the same point. These additions take place in varying amounts of revenue requirements each year for each plan. The study extends over the installation's lifetime, 30 or more years."

Davidson explained that the principle of present worth puts all plans on a common time basis, money having a time value. Present worth, he said, is simply "compound interest in reverse, or compound discount." The present worth of future annual revenue requirements for interest, taxes, depreciation, operation, maintenance, and insurance is obtained for each plan, all thus being placed on a common basis for comparison.

"The present-worth figures," he said, "are usually much greater than the sum of the capital additions, as each such addition generates a long series of future costs." They are, however, usually much smaller than the total revenue requirements to be obtained from the customers because of the compound discounting.

"Although present-worth values are somewhat fictitious," he said, "I like to think of them as representing, for each plan, the money in the bank earning interest, which would be needed to install, maintain, operate, and finally retire the equipment associated with a plan."

He cited these assumptions inherent in this approach to economic analysis:

1. Even though regulatory controls are a fact of utility life, companies operate in the free money market, competing with other industries to obtain funds from investors who have complete freedom of choice.

2. Utilities operate in an expanding situation with continual need for new facilities and new funds.

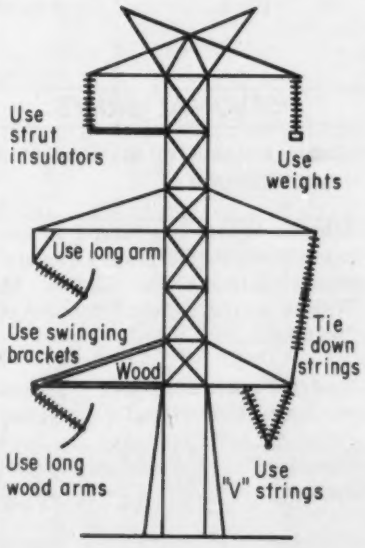
3. Engineers are chiefly concerned with determining the long-range economic picture over the life of the installation, recognizing meanwhile that the short-range effect on the company's books may affect their course of action. They should acquiesce in "uneconomic" choices with full knowledge of what they are doing.

This approach to economic analysis, Davidson explained, tries to achieve an equitable compromise between the conflicting desires of the stockholder to maximize his earnings and those of the customer to minimize his rates.

Industry is loaded with capital equipment, much of which could be retired to the companies' advantage, said D. M. Kammert, West Penn Power Co, in elucidating the economics of property retirement and the allocation of cost to capital and expense.

Equipment retirement, he said, requires a methodology, treating all aspects—costs, rates, maximization of equipment use, insurance. Retirement, even when triggered by some event, should be prepared for in a formal statement, giving the results of a study of all the economic factors.

Cites Ways to Boost Capacity



VOLTAGE can be raised on lines over 50 kv by increasing insulation and shortening insulator swing by any of the means indicated above

Capacity of some old transmission lines can be increased to six times their present rating in four ways:

1. Boost conductor current rating
2. Raise line operating voltage
3. Increase conductor size
4. Bundle conductors.

Concurrent application of all four methods is sometimes necessary and feasible, E. Fritz, Consulting Engineer, Washington, D. C. told the System Planning Committee, Pennsylvania Electric Association, at Greensburg, Pa.

The 1961 revision of the National Electric Safety Code permits lesser ground clearances on lines of over 50 kv and decreases insulator swing angles from 45 to 30 deg, he explained. Furthermore, broken-wire assumptions have been relaxed, and some utilities report that broken-wire loads are not now included in tower designs.

Where electrical clearances are liberal, voltage can be raised by in-

(*Continued on page 106*)

New England Utility Elects Manley President

MANLEY

Francis E. Manley has been elected president of Fitchburg (Mass.) Gas & Electric Light Co. He will succeed Albert G. Neal who is retiring after 52 years in the industry.

Manley joined the general staff of Orange & Rockland Utilities, Inc, in 1935. He was subsequently right-of-way engineer, staff engineer, executive assistant, and assistant vice president. In 1958 he became vice president, the position he has held until his election as Fitchburg G&EL's head.

Vice President's Post Goes to Purcell

PURCELL

James F. Purcell has been elected vice president of public relations for Northern Indiana Public Service Co.

Purcell, who joined the utility in 1953, organized and managed its public relations department. Before coming to Northern Indiana PS, he was an account executive in the public relations consultation firm of Selvage & Lee. He was previously public relations director of American Maize Products Co.

Black Hills P&L Boosts Babbitt to VP

BABBITT

New vice president at Black Hills Power & Light Co is Harry Z. Babbitt. George Weedman has become assistant secretary.

Babbitt came to Black Hills P&L 14 years ago as general superintendent. In 1953 he was made production department manager, and he became chief engineer in 1957.

Prior to serving with Black Hills P&L, Babbitt worked for Kansas Electric Power Co and Northwestern Public Service Co.

PERSONAL BRIEFS

At Kansas Power & Light Co, **Herman F. Schuster** has become assistant comptroller.

Jack D. Schwartz has been named assistant to the Washington division manager of Pacific Power & Light Co.

Dale C. Swancutt has succeeded **Frank N. Savage** as manager of Blachly-Lane County Cooperative Electric Assn. Savage has retired.

Thomas A. Fearnside and **Dr Arthur J. Good** have been elected to the board of Stone & Webster Engineering Corp.

Virginia Electric & Power Co has appointed **B. Albert Burton II** as executive assistant to the Richmond district manager.

John C. Woods has retired as system station engineer for Commonwealth Edison Co. **Clinton O. Willson** retired as superintendent of metering.

Fred I. Smith, sales vice president for Jersey Central and New Jersey Power & Light Companies, has been elected to the boards of the two utilities.

Philadelphia Electric Co has named **Wayne C. Astley** as assistant director of economic and rate analysis.

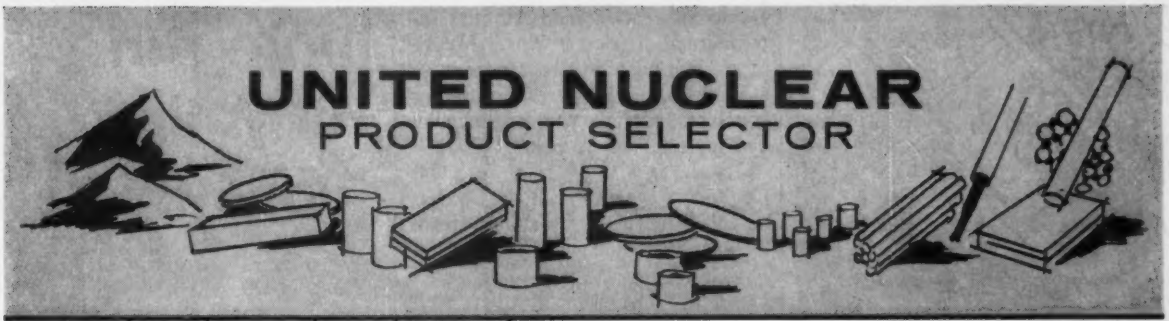
Richard F. Willett has joined Beiswenger, Hoch, Arnold & Associates, Inc, consulting engineers, as vice president and chief electrical engineer.

Southeastern Utilities Service Co has promoted **M. J. Gregory** to secretary-treasurer at the Atlanta office.

Oklahoma Gas & Electric Co has made **T. Houston George** assistant superintendent of generation. **Joe L. Barker** became chief electrical engineer, and **William C. Doty** was promoted to supervisor of fuels and load dispatching.

Robert F. Wade has been named general manager of the Fairbanks, Alaska, municipal electric system.

(*More News About People, p* 98)



	R & D	DESIGN	MFG.	ASSEMBLY	ADDITIONAL INFORMATION
FUEL MATERIALS	✓	✓	✓	✓	Unlimited license as to enrichment or quantity. URANIUM metal, nitride, oxide, carbide, tetrafluoride, trioxide. URANYL fluoride, nitrate, sulphate. URANIUM DIOXIDE ceramic, sintered pellets and other shapes, shot, high fired, special dense. THORIA-URANIA pellets, shot. PLUTONIUM ■ THORIUM ■ OTHER SPECIAL FUELS ■ COLD SCRAP RECOVERY.
ELEMENTS	✓	✓	✓	✓	TUBULAR ■ PLATE ■ ROD ■ CLADDINGS ■ SUPPORTS ■ COLD SCRAP RECOVERY–aluminum, ceramics, cermets, graphite, highly enriched, powder compacts, stainless steel, zirconium, zircalloy.
CORES	✓	✓	✓	✓	ALL COMPONENTS ■ ASSEMBLY ■ SUPPORTING STRUCTURES ■ CONTROL RODS ■ POISONS ■ INSTRUMENTATION ■ RE-LOADS.
REACTORS	✓	✓	✓	✓	SPECIAL PURPOSE–research, engineering test, materials test, low power, mobile compact, fast burst (pulse type).
METALS	✓	✓	✓	✓	FERROUS ■ NON-FERROUS ■ REFRACTORY ■ TOXIC ■ PYROPHORIC ■ SPECIAL SHAPES ■ FABRICATION AND ASSEMBLY to exact customer specifications.
RELATED PRODUCTS AND SERVICES	✓	✓	✓	✓	HEAT TRANSFER SYSTEMS ■ TEST RIGS ■ CONTROL SYSTEMS from single panels to complete process controls. NUCLEAR LABORATORIES AND SERVICES ■ CALCULATIONAL TECHNIQUES ■ TEMPERATURE SHIELDS. RADIATION AND ELECTRONICS SHIELDS (Ray Proof Corp., Stamford, Conn., a United Nuclear subsidiary).

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where the customer benefits from over 13,000,000 man-hours of responsible experience and over 450,000 sq. ft. of specially equipped, privately owned facilities, as evidenced by the manufacture and delivery throughout the free world of over $100,000,000 of nuclear and related products for use by industry and governments.

For complete information, write or call the sales office nearest you.

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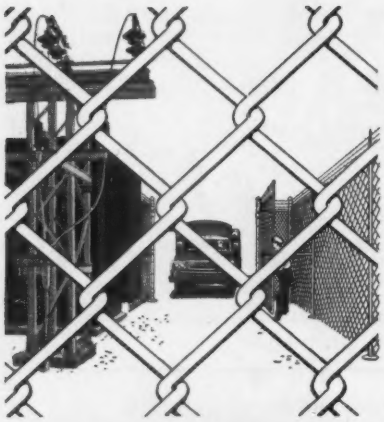

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These 3 VALUES are important

1. QUALITY is important. When you invest in a fence you want it to last for a long, long time. When you specify PAGE you get 77 years of our experience in the design and manufacture of a quality fence. Page Fence is engineered for long-lasting service.

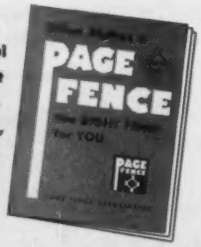
2. WIDE CHOICE is important. For example, we offer a choice of 4 chain link fabrics—ACCO-Aluminized, our latest development, or galvanized steel, stainless, or solid aluminum. Each of these has characteristics which meet individual preferences or make it more suitable to meet certain climatic or service conditions. Furthermore, there are 8 basic fence designs and 6 gate styles. No other company can serve you with so wide a selection.

3. INSTALLATION is important, too. A fence can be no better than the quality of its erection. The Page Fence Member in your locality is trained, experienced, responsible, and interested in your satisfaction.

• • •

When you write us, we'll send you the whole story in a helpful booklet, and the name of our nearest Member. Call him, he will gladly suggest the best answer to your property protection problem.

Helpful booklet describes fence styles, gates and, components



PAGE FENCE ASSOCIATION
National Headquarters • Monessen, Pa.
A product of Page Steel & Wire Division American Chain & Cable Co., Inc.

David Saxe has joined Atomics International division of North American Aviation, Inc, as manager of administration. He is responsible for contract administration, financial and material departments.

De Laval Steam Turbine Co has named **Vincent E. Bochnak** steam turbine sales manager.

Emerson M. Hoyt is the new staff assistant to the director of engineering for TRW Computers Co division of Thompson Ramo Wooldridge Inc.

Leach Corp has promoted **Joseph S. Pares** to general sales manager in charge of all field operations.

William J. McGuckin has become manager of advertising and sales promotion for General Electric Co's computer department. He succeeded **Roy D. Jordan** who transferred to the department's marketing training program as senior applications instructor.

Charles H. Atwood and **F. Perry Wilson** have been appointed vice presidents of Union Carbide International Co.

P. R. Mallory & Co, Inc, has promoted **Max Hutton** to staff engineer of Mallory Metallurgical Co division. He is responsible for special engineering projects and for liaison between the division's engineering group in Indianapolis and customers in the Eastern states.

Ratcliffe Named Manager Of Marketing and Sales

Middle West Service Co has appointed Jack J. Ratcliffe as manager of marketing and sales. He will render consulting services to public utilities and industrial organizations that are Middle West clients. Ratcliffe was formerly sales promotion manager of Public Service Co of Oklahoma.

RATCLIFFE

(*More News About People, p* 100)

more run for your money!

WARN® HUBS

on your

4-WHEEL DRIVE!

That goes double—more run for your money from your vehicle as well as the hubs. Your 4-wheel drive lives longer, handles easier, costs less to own, is more versatile with Warn Hubs, because they "cut out" the front drive in 2-wheel drive — stop drag, save gears, tires, gas. And Warn Hubs give you the utmost in "selective drive" convenience, dependability and satisfaction too, because they are *made* that way. Choose Warn Lock-O-Matics for automatic selective drive, or Warn Locking Hubs for the most dependable manual control hubs. You get more for your money either way.

Models for all makes 4-wheel drives. Ask your dealer for Warn Hubs next time you see him.

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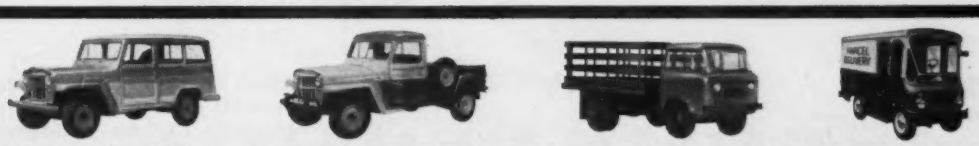
known by the companies it keeps moving

Thousands of leading American companies keep their investment at a minimum with a 'Jeep' fleet. Great versatility and low initial cost give you the most versatile vehicle you can possibly get for your money! Traditionally rugged 'Jeep' construction keeps maintenance costs low and the resale value high. Get in touch with us today for complete Jeep® VEHICLES information! **Write to: Robert J. Kreusser, Fleet Sales Manager, Willys Motors, Inc., Toledo 1, Ohio.**



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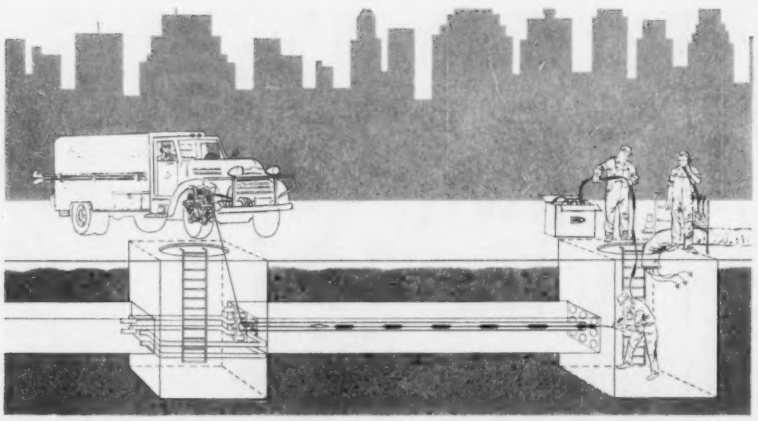

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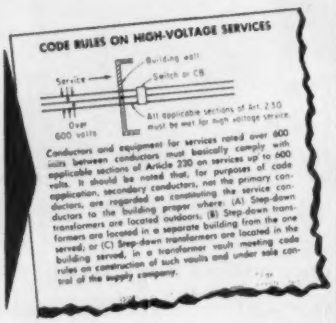
Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment – motors and controllers – conductors – raceways – switches – overcurrent protective devices – switchboards and panelboards – transformers – capacitors and regulators – power sources – high voltage – signals and communications.


CODE RULES ON HIGH-VOLTAGE SERVICES
Building wall
Service
Switch or CB
Over 600 volts
All applicable sections of Art. 230 must be met for high voltage service.
Conductors and equipment for services rated over 600 volts between conductors must basically comply with applicable sections of Article 230 on services up to 600 volts. It should be noted that, for purposes of code application, secondary conductors, not the primary conductors, are regarded as constituting the service conductors to the building proper where: (A) Step-down transformers are located outdoors, (B) Step-down transformers are located in a separate building from the one served, or (C) Step-down transformers are located in the building served, in a transformer vault meeting code rules on construction of such vaults and under sole control of the supply company.

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(273-076)

SALES ASSIGNMENTS

COMPANY STAFFS

Thompson Ramo Wooldridge Inc has appointed James A. Brosovic as central region district sales manager for TRW Computers Co division.

Westinghouse Electric Corp has named Stephen N. Donahoe district manager in Milwaukee, succeeding John A. Holden who retired.

Minneapolis-Honeywell Regulator Co has promoted Richard T. Waits Jr to eastern regional industrial manager with headquarters in Long Island City, N. Y. He succeeded D. W. Fryback who became account executive in Hartford, Conn. Joseph A. Bowman became utilities market manager for the industrial products group. George S. Raab succeeded Bowman as branch sales manager in Detroit, and William B. Wells was named branch sales manager in Dayton. Jack W. Larsen became branch sales manager in Cincinnati, succeeding Ralph A. Lewtas who was named training coordinator and application engineer for the central region.

Radio Corp of America has assigned Vroman W. Riley sales responsibility in 15 Eastern states for the microwave department. He succeeded R. J. Fichthorn who was transferred to the department's national accounts group. Matthew H. Cattanea became manager of inter-divisional sales for the commercial systems department of the electronics data processing division.

Bailey Meter Co has made R. T. Cowan Chicago district manager; J. A. Lucas, Detroit district manager; and R. E. Byers, Milwaukee district manager.

General Electric Co has named Leonard D. Thompson sales engineer for heating controls at the appliance control department, Morrison, Ill. F. I. McDaniel became north Texas district manager for the major appliance division, sales and distribution department. He succeeded I. Pickney Pruitt who became national manager of contract sales for the sales and distribution department. G. J. Schroeder was named sales representative for the central district of the silicone products department, with offices in Chicago.

Elliott Co has made John L. Sullwold manager of the Los Angeles district, covering southern California, the southern tip of Nevada, and all of Arizona.

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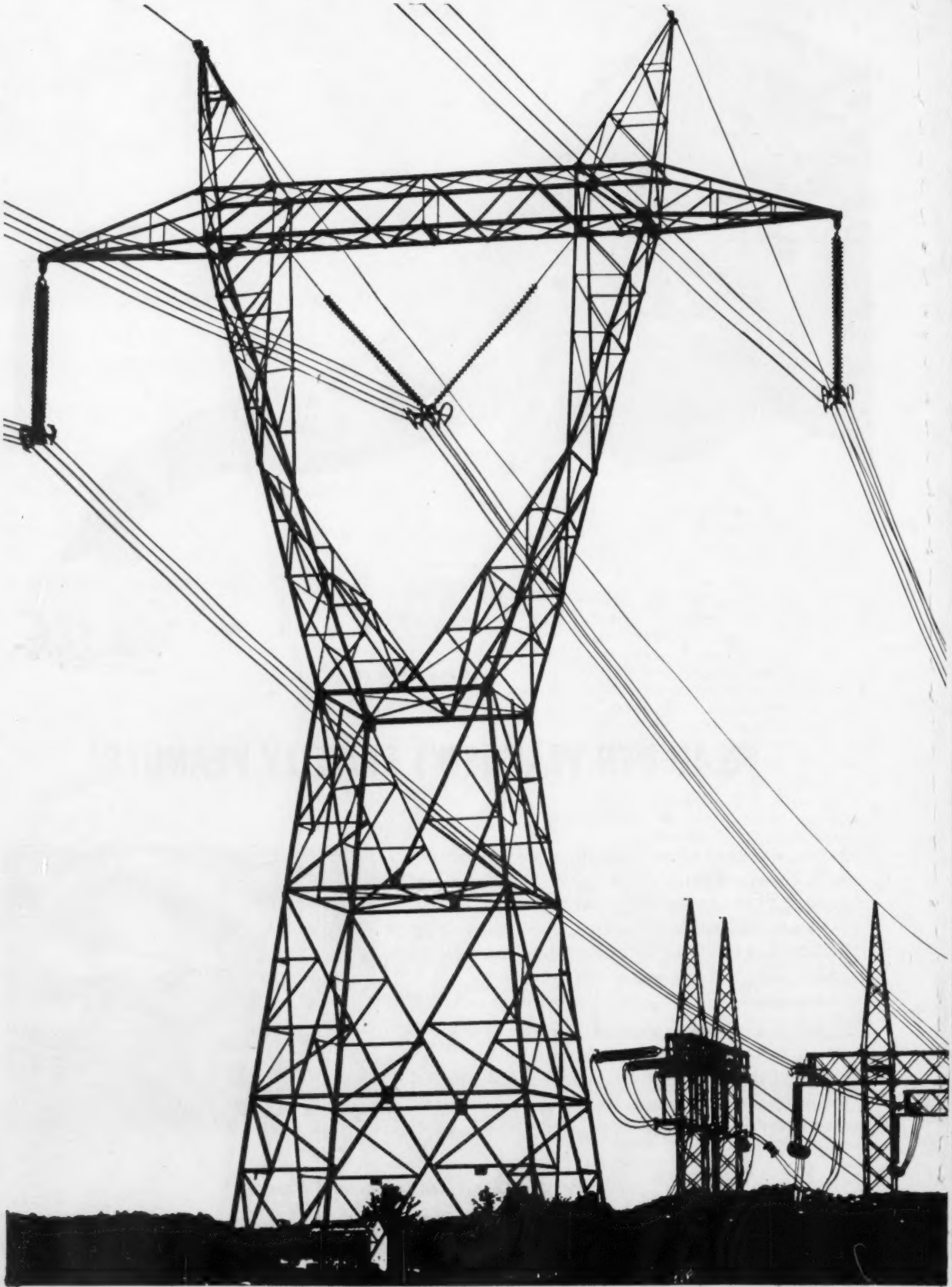

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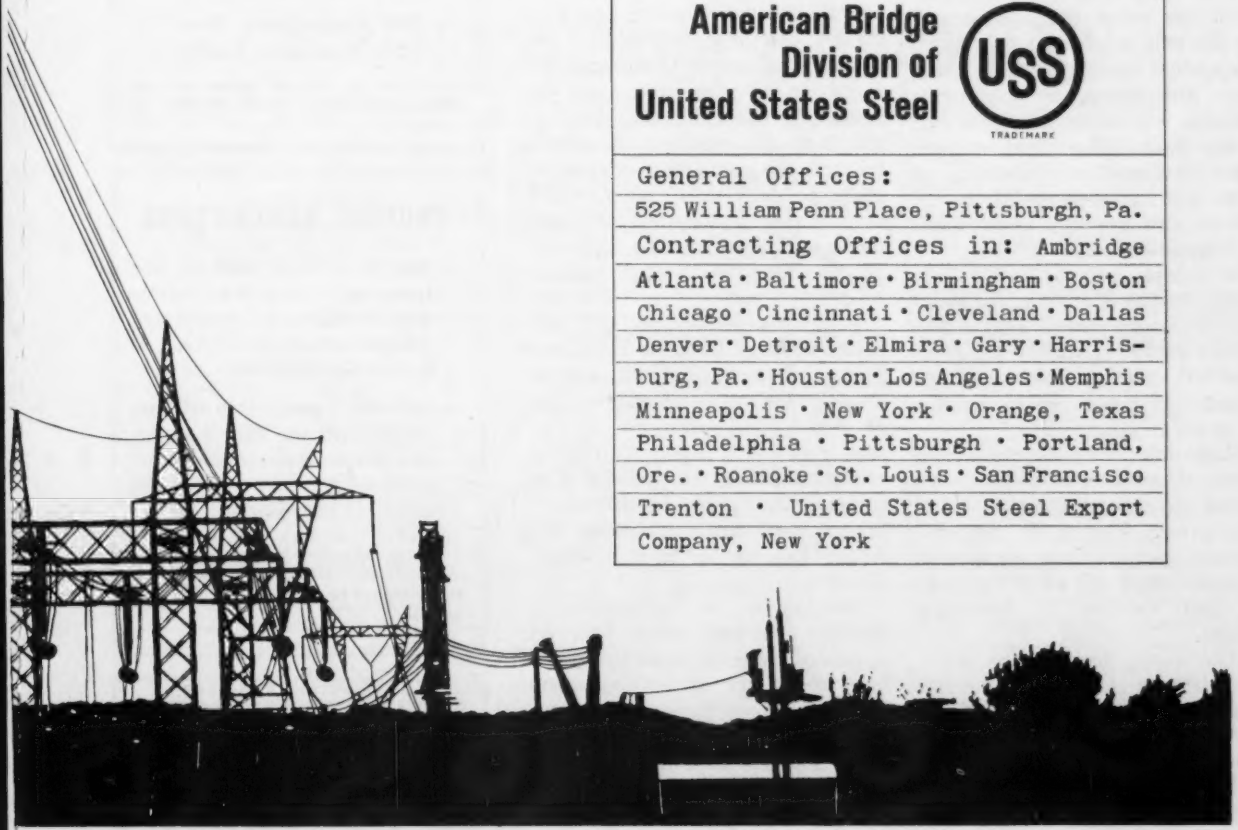

Automatic Control for Sewaren

(*Continued from page 57*)

Furthermore, the computer's electronic equipment will establish priorities for computer action upon sensing significant changes in plant conditions, malfunctions of the automation equipment, or upon signals from the digital clock for initiating specific routine functions.

Whenever priority is disputed, the computer will remember how far it has gone in the program of lesser priority and turn to the more important task immediately. Upon completion of the latter, in the absence of other higher priority tasks, the computer will return to the completion of the original program.

All analog inputs will be logged upon demand. The operator may select groups of inputs or the entire array. Up to four points can be trended visually on digital read-out devices, and a record of the trend of as many as ten points can be typewritten for a record copy.

Sub-loop control will trip the unit directly for 24 plant conditions, and 22 circumstances will cause the control computer to trip the unit. In general, measurement of quanities which can cause the computer to trip the unit will be made by three independent sensing devices. Computer programing, by comparing readings, will detect failure of one of the three independent sensors. When deviation is abnormal, an alarm will be typed to inform the operator that a specific sensor reading is questionable.

An exception to the use of three sensing devices is made in the gauging of hydrogen purity. That it may provide desired reliability, the computer will calculate rate of change of hydrogen purity besides reading the absolute value.

Flame detectors will monitor each burner. Upon loss of ignition, this control will remove affected burners from service. Part of the computer program will determine the course of action which will effect the number and location of remaining burners.

Main steam flow will be determined from three independent measurements of feedwater flow. Cold-reheat steam flow will be computed from a heat balance, feedwater-flow and enthalpy-rise calculation being used. This computed value will be checked for reasonableness with a measured cold-reheat steam flow. For other steam flows related condensate flows will be used, if possible. Otherwise, the actual steam flow will be measured.

As present expectations are to run the entire acceptance test, along with routine tests, with the computer, the instrumentation must be precise, rugged, and retentative of calibration. Accordingly, some measurements will be taken somewhat differently than in the past. A product resolver will measure electrical output; a servomanometer the feedwater flow; and, turbine-type flow meters the low-pressure gland leak-off flow.

Several protective measure are planned against malfunction within the automation equipment. Normal power to the back-up scanner will come from a floating internal battery and associated inverter. Were the inverter to fail, fast transfer will be made directly to station power.

Failure of the computer, itself, will actuate an alarm informing the operator while preventing operation of any computer output that can actuate equipment. Additional information on plant status and the reason for difficulty may be presented to the operator in certain failures. Program safeguards will include a "dead man" timer, which must be reset frequently by the computer, and a programing technique assuring the proper output device is actuated.

Sewaren operators per shift will not be reduced from the three now used as a conventional unit. Retaining this unit will enable the training of men in its operations, so that such men will be ready for manual operation during the de-bugging of computer operation. The reductions in personnel for calculations and testing has yet to be fully determined.

This article has attempted to identify and shed some light on certain of the more important problems which arise in the application of control computers to steam plants. It is hoped that these comments will help those now conducting studies to develop automation policies for their companies.

SEARCHLIGHT SECTION

Continued on page 105

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Letters (*Continued from page 5*)

336.4-MCM ACSR will become economic sometime during this period.

Annual costs versus years are plotted for both conductor sizes. These curves will cross at some year with the larger conductor showing lower annual costs from that point on. The load for this will correspond with the load on Mr Gray's curves where the larger conductor becomes economic.

According to Mr Gray's concept, the time to change to the larger size would be just before the crossing point so as to take advantage of the lower annual costs as they begin. However, there are some arguments of considerable merit which indicate that the changeout might be delayed without upsetting the economics. The curves show that for each year before the crossing point the smaller conductor operates at a saving in annual costs. These are theoretical savings but, if you consider the losses which in theory would accrue through use of the smaller conductor after the crossing point, you must also consider the savings before that point.

This brings us to the possibility that the larger size does not become economic at the crossing of the two curves but rather at the point where the summation of theoretical losses in annual costs after that point equals the summation of the theoretical savings before it. Thus, the point is not critical since the equating of savings and losses will extend the period of economic use of the smaller conductor. This does not mean that the changeout would be delayed until the last moment, but it does allow time for exercising of engineering judgment in timing the changeout or to take advantage of some other system development which would render the changeout unnecessary.

One of the risks inherent to situations which extend over a long period is that system requirements may dictate that some other improvement be undertaken near or just beyond the period (which) will result in substantial reduction in load on the new substation which would divide this feeder into two shorter ones. Considerable over-investment might be made if the larger conductor had been installed indiscriminately since the reduction in load could vary easily reverse the apparent economics.

Application of this or any other method of determining conductor economics will not provide the complete solution. The final solution will only be as sound as the validity of the data, the accuracy of the analyses of all factors involved, and the degree of engineering judgment exercised. There will be many instances where the basic approach in Mr Gray's excellent article could be augmented, giving the engineer a more complete picture of expected results. This, in turn, would lead to better engineering judgment and decision.

I. V. Czeskleba
Long Corner Road
Mt. Airy, Md.

PEA Planners Meet

(*Continued from page 95*)

creasing the insulation and shortening the insulator swing, Fritz continued.

Duquesne Light Co will increase voltage on its 69-kv ring to 138 kv, said W. C. Lauth, adding that newly introduced strut insulators will control the jumpers in the restricted space on the 69-kv towers. Conversion costs a third to a half the outlay for a new line.

Also important are the system planning aspects of this voltage conversion, said A. Bartosh, also Duquesne Light. Savings will result from flexibility to adjust to unforeseen loads or change in generator locations, transmission capacity to handle 20 years of load growth, and maximum development of present plant sites.

Transmission planning criteria for Duquesne Light Co are: (1) System peak load can be carried with no overloads; (2) line loadings will not exceed the 24-hr emergency rating on circuits remaining after one major unit or tower line goes out; and, (3) load will not exceed the 1-hr emergency rating on any circuit during the area peak with the above contingencies.

Knowing maximum thermal capacity of conductors enables a utility to make best use of transmission conductors. A new formula, developed by H. W. Wright, Pennsylvania Power & Light Co, considers the small probability of simultaneous occurrence of high temperatures, low-wind velocity, and maximum circuit loading to give high conductor current ratings.

A new way of estimating residential distribution transformer loads, using Monte Carlo techniques, has been developed by David Reps, Westinghouse Electric Co. It combines individual appliance-use patterns to simulate transformer loads.

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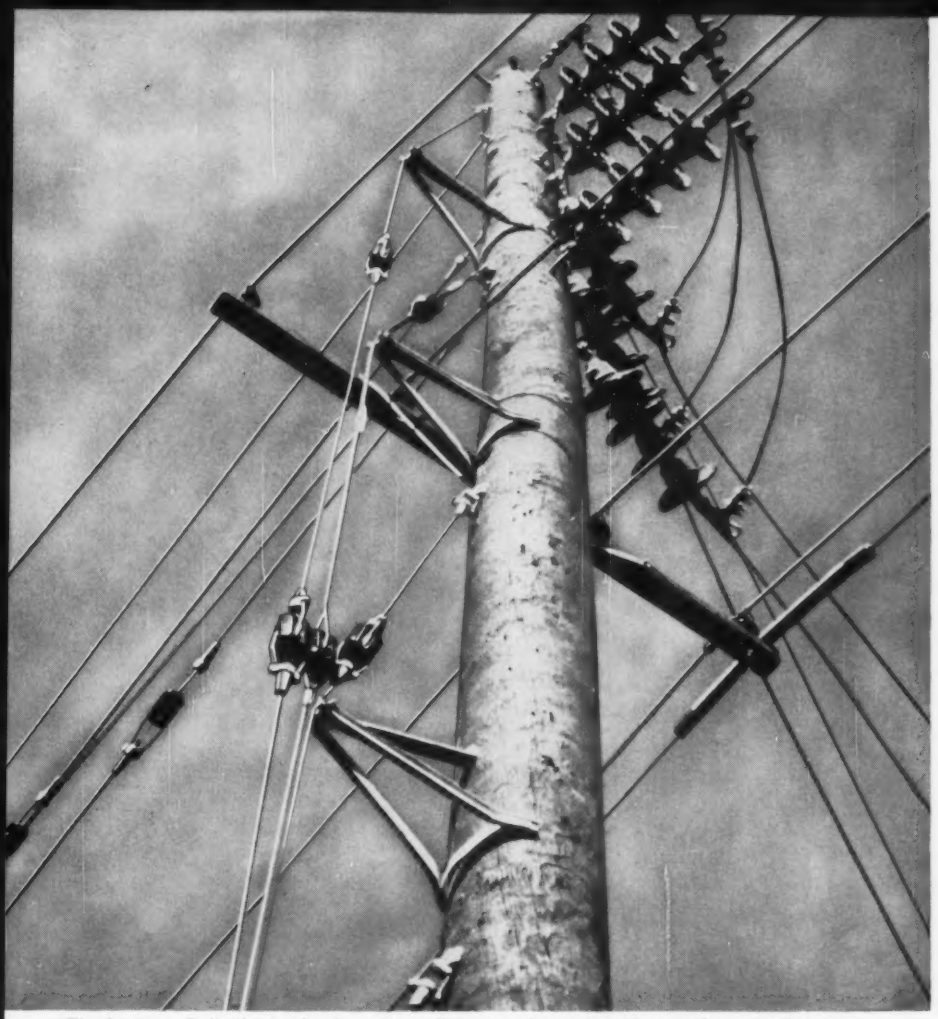

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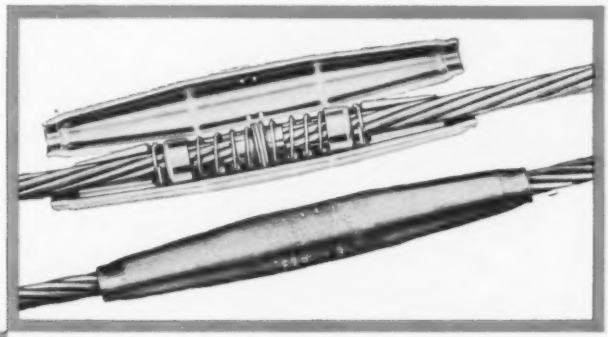

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180-1000	0-1/5/10/50	460-1000 MC
181-250	0-10/50/100/500	25-250 MC
181-1000	0-10/50/100/500	200-1000 MC
270-30	0-50/100/500/1000	2-30 MC
270-75	0-50/100/500/1000	10-75 MC
270-470	0-50/100/500/1000	70-470 MC

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